November 1966
75¢

CQ

K2PZV

see page 10

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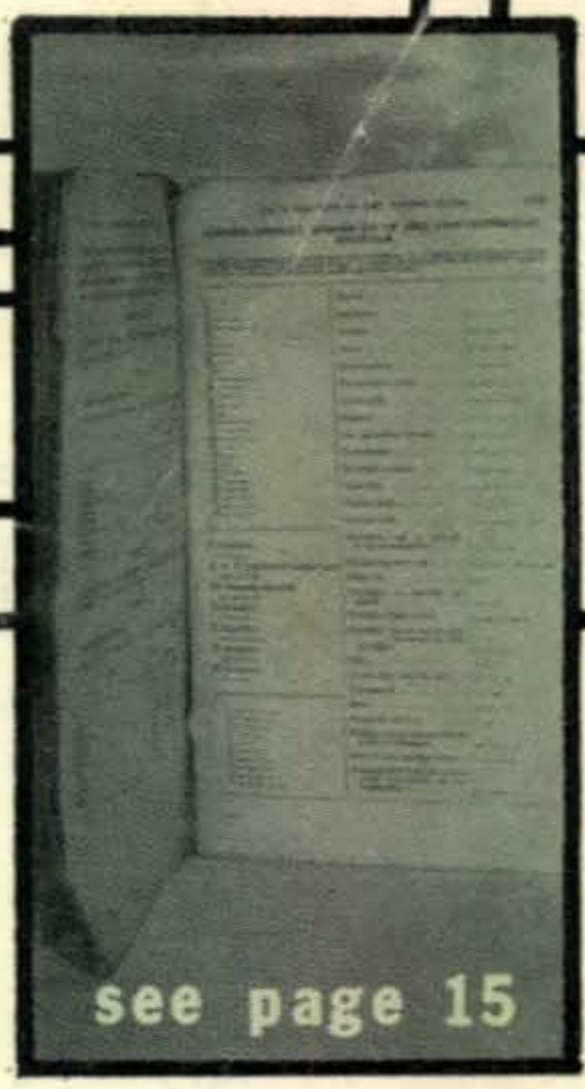

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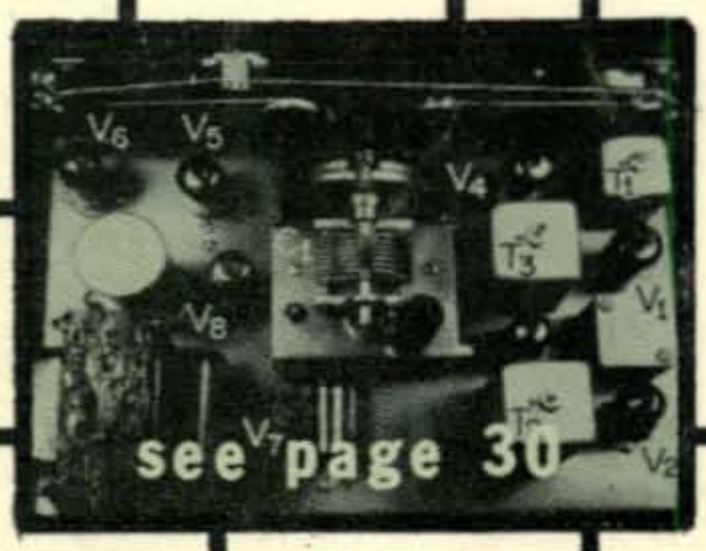

see page 30

The Radio Amateur's Journal

FULL MEASURE OF PLEASURE

Collins accessories add more enjoyment to working your rig. Each Collins accessory is styled to be an attractive addition to your equipment.

The 312B-4 Speaker Console (1) streamlines the operation of your S/line by integrating units into an operating system. It also includes a speaker and directional watt meter.

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See these and many other ham pleasers at your Collins distributor.

K2PZV

COLLINS

For further information, check number 50 on page 110

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Hustler quality and reliability with

ONE TUNING ADJUSTMENT TO COVER BOTH PHONE and CW

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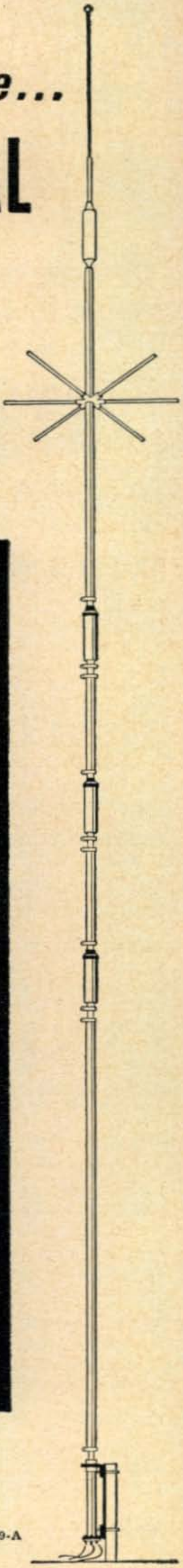

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6439-A

For further information, check number 20, on page 110

Hallicrafters advanced technology brings you a new breed of amateur equipment

SX-146 Receiver

This is an amateur band receiver of advanced design employing a single conversion signal path and pre-mixed oscillator chain to assure high order frequency stability and freedom from adjacent channel cross-modulation products. The SX-146 employs a high frequency quartz crystal filter and has provision for installation of two more crystal filters. The receiver may also be used from 2 to 30 mc, with the exception of a narrow gap at 9.0 mc, with the connection of auxiliary oscillators. The highly stable conversion oscillator chain may be used for transceiver operation of the matching HT-46 transmitter.

FREQUENCY BANDS: 3.5-4.0; 7.0-7.5; 14.0-14.5; 21.0-21.5; 28.0-28.5; 28.5-29.0; 29.0-29.5; 29.5-30.0 mc (28.0 to 28.5, 29.0 to 30.0 requires extra crystals at users option).

SENSITIVITY: Better than 1 μv for 20 db S/N.

TUBES AND FUNCTIONS: 6JD6 RF amplifier; 12AT7 Signal mixer and cathode follower; 6AU6A 9 mc IF amplifier; 12AT7 AM detector—AVC rectifier—product detector; 12AT7 USB—LSB crystal oscillators; 6GW8 Audio amplifier and audio output; 6BA6 Variable frequency oscillator; 6EA8 Crystal heterodyne oscillator and pre-mixer; Plus diode power supply rectifier, ANL diode and AVC gates diode; *6AU6A—100 kc crystal calibrator oscillator; *Harmonic generator diode.

PHYSICAL DATA: Size: 5⅞" x 13⅛" x 11". Shipping wt., 20 lbs.

FRONT PANEL CONTROLS: Frequency: Power off CW-upper-lower and AM; Audio gain; Band selector—3.5, 7.0, 14, 21.0, 28.0, 28.5, 29.0, 29.5; Selectivity—0.5, 2.1, 5.0 kc (0.5 and 5.0 kc filters optional extra); Pre-selector; RF gain; AVC on-off; Cal. on-off; ANL on-off; Phone set jack; S-meter.

REAR CHASSIS: S-meter zero adjust; Internal-External oscillator switch; Slave oscillator output; External oscillator input; Antenna socket; Speaker, ground and mute terminals; Grounding stud; AC power cord.

POWER REQ.: 105/125 volt—50/60 cycle AC—55 watts.

I-F SELECTIVITY: Uses a 6-pole crystal filter to obtain a nose-to-skirt ratio better than 1 to 1.8.

Amateur net, $269.95

Model HA-19 plug-in, 100-kc quartz calibrator available as accessory. **Amateur net, $19.95**

**Part of HA-19 calibrator.*

HT-46 5-band transmitter

All new from the ground up! Here's the "new breed" transmitter that matches your SX-146 . . . works independently or may be interconnected for transceiver operation.

FEATURES: 180 watts PEP input on SSB; 140 watts on CW; Frequency control independent or slaved to SX-146 receiver; Upper or lower sideband via 9 mc quartz filter; Built-in power supply; Press-to-talk or optional plug-in VOX; grid block for keying for CW.

FREQUENCY COVERAGE: 3.5-4.0, 7.0-7.5, 14.0-14.5, 21.0-21.5 mc and 28-30 mc in four 500-kc steps. Crystal supplied for 28.5-29.0 mc coverage. Other plug-in crystals at user's option.

TUBES: 6BA6 VFO; 6EA8 Heterodyne crystal oscillator and mixer; 12AT7 Carrier oscillator-third audio; 12AT7 Mic amplifier; 6EA8 9 mc I-F amplifier and AALC; 6AH6 Mixer; 12BY7 Driver; 6HF5 Power amplifier; 0A2 Reg.

FRONT PANEL CONTROLS: Frequency Tuning; Operation-Off, Standby, USB, LSB, CW-Tune, Standby LSB USB; Microphone gain; Driver tune; Carrier level; Band selector; Final tune; VFO selector—Transmitter-Receiver; Dial cal.; Calibrate Off-On; Meter MA-RFO.

REAR APRON FUNCTIONS: AC Cord; Ground lug; Fuse; Key jack; VOX accessory socket; Antenna jack; Receiver input (for transceiver); 11 pin control socket; bias adjust.

PHYSICAL DATA: Size: 5⅞" x 13⅛" x 11". Shipping wt., 26½ lbs.

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4 x 6 inch oval speaker and attractive 24 hour clock.

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CQ

NOVEMBER 1966 VOL. 22, No. 11

The Radio Amateur's Journal

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Editor

ALAN M. DORHOFFER, K2EEK
Associate Editor

IRVING TEPPER
Technical Editor

WILFRED M. SCHERER, W2AEF
Technical Director

CONTRIBUTING

FRANK ANZALONE, W1WY
Contest Calendar

GEORGE JACOBS, W3ASK
Propagation

BYRON H. KRETZMAN, W2JTP
RTTY Consultant

A. EDWARD HOPPER, W2GT
USA-CA

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DX

LOUISA B. SANDO, W5RZJ
Staff Reporter

CHARLES J. SCHAUERS, W6QLV
Ham Clinic

BUSINESS

SANFORD R. COWAN
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HAROLD WEISNER, WA2OBR
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EIMAC

3-400Z's used in prototype 6-meter linear amplifier for 2 kW PEP at 50 MHz

The prototype Swan linear amplifier shown here uses two EIMAC 3-400Z triodes in grounded grid circuitry to achieve two kilowatts PEP input at 50 MHz. Drive power is less than 100 watts PEP. The prototype amplifier features a tuned cathode circuit for low intermodulation distortion, and uses a pi-network plate tank circuit. The new linear may be driven with modern six-meter SSB transceivers, and offers real operational economy at 50 MHz.

Swan chose EIMAC 3-400Z's because these compact, high-mu power triodes are ideal for grounded grid operation. They can provide a power gain as high as 20 in a cathode-driven circuit.

For more information on EIMAC's line of power tubes for advanced transmitters, write Amateur Services Department, or contact your nearest EIMAC distributor.

3-400Z TYPICAL OPERATION (Minimum IM Distortion Products at 1 kW PEP Input)	
DC-DC Plate Voltage	2500 V
Zero-Sig DC Plate Current*	73 mA
Single Tone DC Plate Current	400 mA
Single Tone DC Grid Current	142 mA
Two Tone DC Plate Current	274 mA
Two Tone DC Grid Current	82 mA
Peak Envelope Useful Output Power	560 W
Resonant Load Impedance	3450 ohms
IM Distortion Products	−35 db**

* Approximate

** −35 db or more below one tone of a two tone test signal.

We have a new brochure entitled "Linear Amplifier and Single Sideband Service." Write for your copy.

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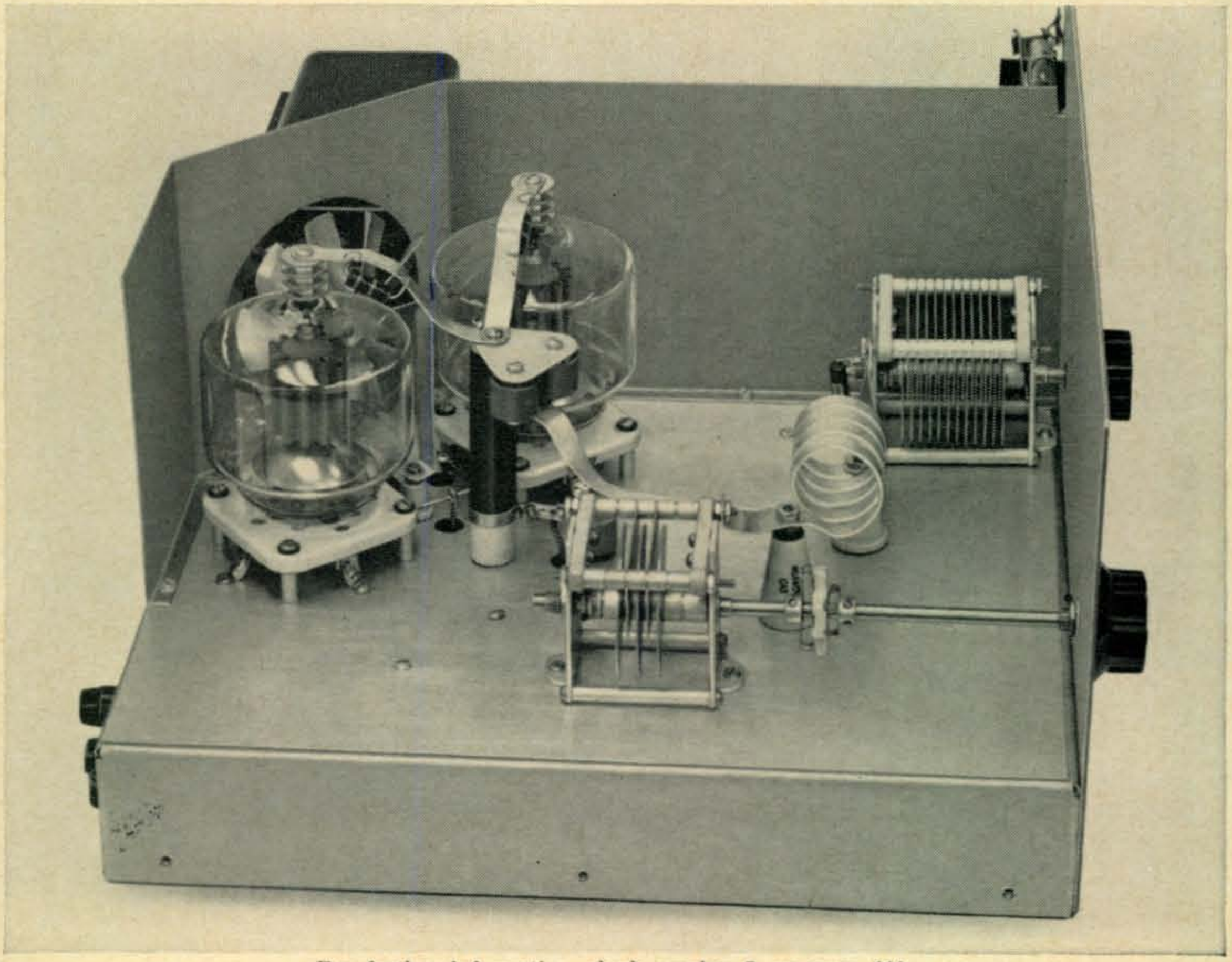

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LAFAYETTE 6-Meter Solid-State Transceiver

Completely Portable And Mobile —
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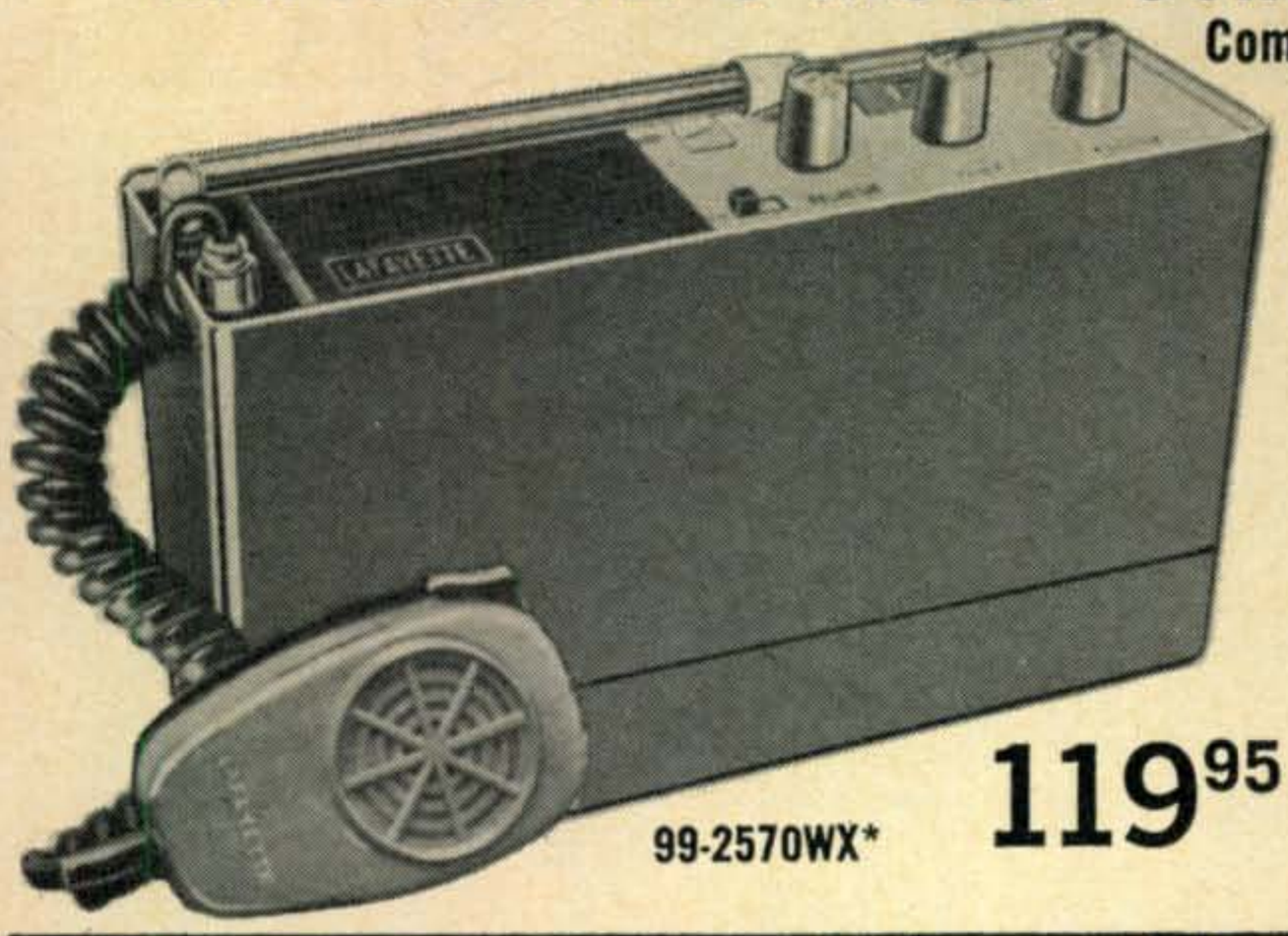

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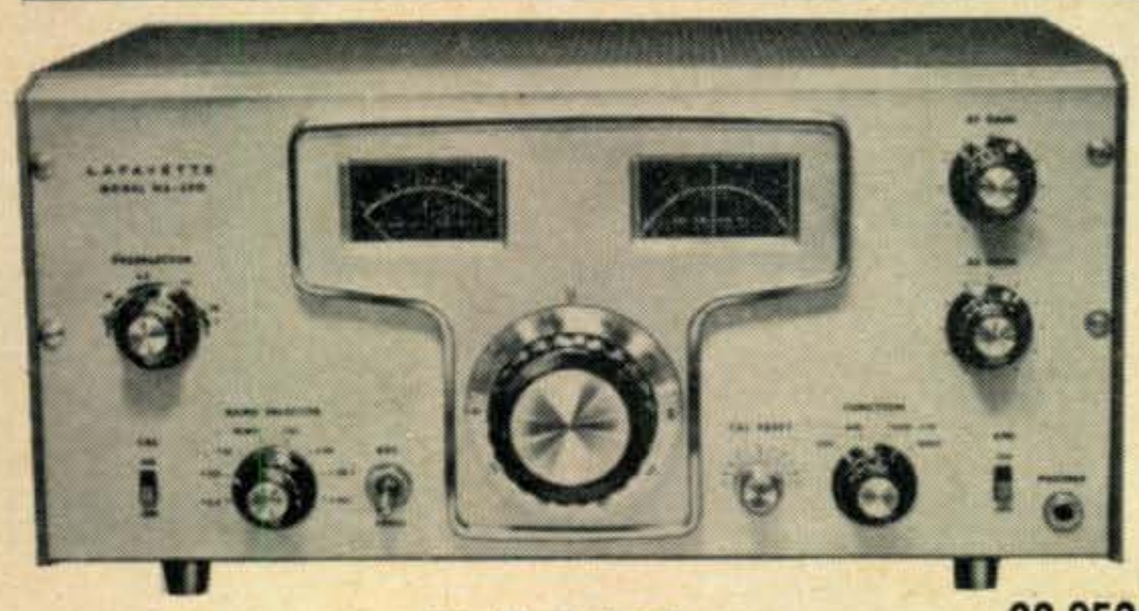

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OUR READERS SAY

Hams and CBers (cont.)

Editor, *CQ:*

As a rule, I do not write, either pro or con, on any issue, unless I get steamed up. Well, I am up in arms about some of the con replies that I read in the September issue of *CQ* magazine.

Referring to W4STX letter in your column, I was dismayed at the attitude that was flagrantly displayed. How come the holier than thou attitude? Was this fellow so put out acquiring his license that he feels the whole Ham Fraternity should be isolated from any individual that has a bonafide interest in Amateur Radio? If this is true, and he represents too much of this so called "fraternity" then I can tell you here and now, that the ranks will get thinner to the point of extinction. I honestly think that the BASIC reason that there are not more people learning the code, is the attitude that is prevailing at this time on the bands and I can say, right now, that I am doing my darndest to cancel out some of the most biggoted amateur mouthings that I have ever heard.

I encourage, and will help, to the utmost of my ability, any CBer or other interested party, to get his ticket, providing that he displays an avid interest in Amateur Radio and this is exactly what most of the CBers have, or they would not be there. We all know what a thrill it is to hear stations all over the States when the Skip is on, and the amount of restraint that is needed to keep within the regulations, is exactly the amount needed by the DX hound to stay within our bands and not go down, get him and drag him up or tell him where you can be found.

In conclusion, I would like to ask all concerned to give a little more encouragement and accommodations to the true CBer, and keep all the snobbery off of the Ham Bands so interested parties can tune in and see what Amateur Radio is really like.

Jack Golden, WA2YPW
Portville, New York 14770

Editor, *CQ:*

I am one of the lowly CBers, many of whom read books and magazines aimed at the radio amateur. I have been reading your lines in Zero Bias with great interest. I feel that you should be lauded and commended for your train of thought, concerning better relations and perhaps inducing the "hams" to encourage the CBer to fulfill his hamming instincts by becoming a ham. Quite a few hams hold CB licenses also, and use CB as it was intended and a few also "ham" it up on CB. A few CBers have joined the ranks of amateur radio operators and a lot more would like to.

Let's you and the rest of the hams look at a classic example of a CBer—Me! I've been associated with hams on and off since my teens, I'm now forty years old and still not a ham. I owned an HQ-129 X several years ago. I've worked in radio and television service to some extent; my present jobs requires electronic skill. I've built receivers both regen. & superhet, v.f.o.'s, transmitters, R-C devices, and gave them away or sold them.

Along with other CBers I've learned to wring that last bit of r.f. out of antennas. You have to if you want to maintain communications on base and mobile operations especially when all you can start with is five watts input. Now, why have I not already become a bonafide ham? I seem to have a mental block about c.w. I get up to two or three w.p.m. and then poof! I just cannot seem to soak up that blankety blank code. To me it seems useless. . . .

Now I have a few comments to make about CBers bending the rules and also breaking a few of them. Yes, I'll admit we do and to be honest I've picked up a couple of white sheets (FCC form 793) myself for minor infractions. Put yourself in the CBer's shoes. If you had five watts input and an antenna you sweated over trying to get that last bit of r.f. to jump off into space, wouldn't you want to see what you could do with it? I've heard one ham tell another one night that some of the CBers could do more with five watts than most hams can do with thirty or forty watts. But by the same token you can sit back almost any Saturday night and listen to "75" & "80" and catch the 91.13—97,113—91,115 and worst of all the 97,119, especially when two certain A.M. kw's down in W4 land get on and defy any s.s.b. op or anyone else to cover them up. Oh! Well that's enough! This pro and con could go on and on.

However, I am going to try one more time to bust this c.w. mental block I've got. In a couple of weeks I am going to order more code records and a new Lafayette HA-500 receiver, so maybe I can copy in on W1AW. If I lick this c.w. I want to go for my general. Then maybe I can put CB to use for what it was intended and do my rag chewing on the "ham bands." But you know as well as I do as soon as I heard Channel 11 I had to open my tater trap too. So it goes with all CBers. If you wish to use this letter in any way to illustrate a point, you have my full permission. Thank you.

Dale E. Coriell, KLK4322
New Albany, Indiana 47150

Good luck with the code, Dale, and if you like what you find on the ham bands tell your friends.—*K2MGA*

"OUR READERS SAY" welcomes letters about nearly anything of interest to amateurs, whether about *CQ* itself, the state of the hobby, or whatever else you have on your mind. The most interesting letters will be selected for publication each month; just keep them legible, keep them short, and above all, keep them clean! Something bothering you. We're not mind readers, OM, so drop us a line.

The Perils Of Sylvia

Editor, *CQ:*

Re: criticism in Sept. 1966 issue concerning previous articles from the pen of Sylvia Margolis. Sorry, but just can't agree with WØEUQ's statement that her writings leave something to be desired. I find these to be most delightful, wouldn't miss one for anything. She displays the most uncanny and clever wit that I have ever seen in any amateur journal. Granted that she does not draw up a bunch of complicated schematics & diagrams, but her articles certainly reflect a tremendous knowledge of the ham fraternity, knowledge that could only be written by one who has "been down that road." So, come on now, WØEUQ, try to muster up a little good ole American sense of humor—you can find schematics and technical info galore on almost any other page.

Buck M. Williford, W5LKL
Odessa, Texas

Thanks for agreeing with us Buck, we think Sylvia is terrific too.—*K2MGA*

Buy Or Build

Editor, *CQ:*

In the September HAM CLINIC column, a Novice asked for advice on the purchase of new equipment, with the 600 dollars (!) which his parents will give him when he passes the General Class exam. He was advised to spend the money on a transceiver, antenna, and microphone.

In my opinion, this young fellow would do much better to spend about one sixth of this money on the parts needed to build a small c.w. transmitter, and a simple receiver, commensurate with his present technical knowledge. As he progresses, becoming a skilled c.w. operator, and acquiring greater technical ability, he can build more

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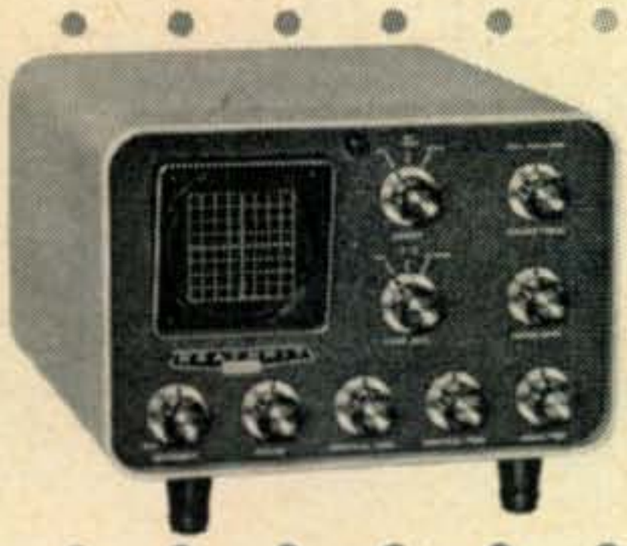

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advanced equipment, and in this way, become a real radio amateur.

Surely this will be much more rewarding than becoming just another windbag appliance operator, who has to send his rig back to the factory for repairs.

Robert V. McGraw, W2LYH
Riverhead, New York 11901

Chuck's suggestion might be more practical if the fellow doesn't stick with it, but we tend to agree with you. *—K2MGA*

Antennas And QTH's

Editor, *CQ:*

Ken Glanzer's article "Ground Radials for Beam Antennas" in Sept. *CQ* was indeed interesting. I don't intend to pick an argument with K7GCO since he is one of the best informed antenna men in the country. However, in his relatively QRN free Seattle location (I lived in Tacoma a while, myself.) he forgot to mention an important reason for radials of any pattern on antenna towers; i.e. lightning protection.

Here on the Florida west coast, which has a higher yearly total of thunderstorms than any other spot in the nation, we are very conscious of this danger. Since the sandy soil has poor conductivity a radial system or a series of deep ground rods connected together is a must for good protection. I'm reminded of this all summer as I watch the fire playing around my 60 ft. Rohn tower, more commonly known as the neighborhood lightning rod. A few weeks ago a house down the street was burned out and the occupant killed by a fire cause by lightning.

Also, the theory that a beach front QTH is the ultimate station location is valid only if you are not plagued with the power line noise which most Fla. beach communities have; Chamber of Commerce propaganda not withstanding. Theoretically Key West would be an ideal location, surrounded as it is by salt water, but the line noise down there usually ruins reception. This is probably dut to salts condensing on the lines with resulting corrosion and shorting of insulators. It may also be due to the power lines being patched frequently due to hurricane damage, and generally poorer utility line maintenance in the smaller beach communities. The only cure is an isolated beach front QTH with the utility line run underground a long distance; something out of the reach of most hams who have priced Fla. water front property lately. I wish I had one, hi.

Keep up the good articles, such as K7GCO's, in *CQ*.

Ken Stewart, W4SMK
Fort Myers, Fla.

Check the QTH on page 49—*K2MGA*

There Are Other Hobbies

Editor, *CQ:*

I am 15 years old and should have my license (Novice) in a month or so. *CQ* has printed at least one account of a network operating for scientific purposes. I believe that this was called the "ASTRONET."

One ot my hobbies, outside of Ham radio, is amateur seismology. I operate a small seismograph in my cellar. It would be possible, with the joint support of other interested Hams, to organize a network of seismograph stations linked by Ham radio. Information from the various stations could be relayed to a central station for analysis. In that way, within minutes after an earthquake, every station in the network would be alerted and data on intensity, direction and range could be transmitted.

The requirements for joining the network would be simple. All you would need is a small, simple seismograph with accurate time calibration and a Ham station for either 40 or 80 meters.

I would appreciate any comments either you or "Hamdom" have on the subject.

Duane B. Fowler
East Middlebury, Vermont

Sounds interesting, good luck.—*K2MGA*

For further information, check number 26, on page 110

Announcements

Anthony, Kansas

The State Line Amateur Radio Club will sponsor a Hamfest on November 6 at the Municipal Building in Anthony, Kansas. Free registration. A covered dish luncheon will be served at noon. For more information contact Wilma Plank, WAØBJC, 311 West 15th, Harper, Ks.

Banksville, N. Y.

The Harmonic Hill Radio League of Mt. Kisco will be holding their annual "Swap & Sell Auction" on Saturday, November 19, 1966. Auction starts at 2 p.m. at the Auto Auction building in Banksville, New York, located on the Greenwich-Bedford Rd, 4 miles north of Exit 31 on the Merritt Parkway. For further information contact Jim Ferris, WA1DQL, at 203-661-8245.

Lafayette, Louisiana

The annual banquet and program of the Lafayette Amateur Radio Club will be held in Lafayette, La., on Saturday, December 3, at 7 p.m. on the campus of the University of Southwestern Louisiana. All area hams are invited and more information is available by contacting Club President W5EXI, Edward G. Miller, 612 Harding, Lafayette, Louisiana, 70501.

F.C.C. Announcement

Late word received from the F.C.C. states that a third party agreement has been reached between the U.S. and Uruguay. This agreement will be effective as of Sept. 26, 1966.

WWV QSL Card

Boulder, Colo.—Amateur radio operators around the World can have a handsome new QSL to add to their collection—provided they can qualify by receiving National Bureau of Standards' radio station WWV on its first day of broadcast from its new location at Fort Collins, Colorado.

The lucky QSLers will receive a special First Day QSL Card handsomely bordered in gold and depicting the new WWV site at Fort Collins, Colorado. Each QSL card will have stamped on it the date and time of WWV reception. The three amateurs showing earliest reception time will receive, in addition, a framed 11 x 14-inch color photograph of the scene appearing on the QSL card.

WWV, presently located at Greenbelt, Maryland, is is scheduled to begin its Colorado broadcasts at 0000 hours Universal Time, December 1, 1966. This is equivalent to 8:00 P.M. AST; 7:00 P.M. EST; 6:00 P.M. EST; 5:00 P.M. MST, and 4:00 P.M. PST—all on November 30th.

Recipients of the WWV broadcast who wish to qualify for the First Day QSL Card will be required to correctly quote the new WWV voice announcement and to have their reports postmarked before midnight December 2, 1966, local time. Cards should be addressed and mailed directly to David H. Andrews, Chief, Frequency-Time Broadcast Services Section, Radio Standards Physics Division, National Bureau of Standards, Boulder, Colorado, 80302.

Correction

In the article "A Phase Locked Local Oscillator For Advanced Receiver Design" in the September 1966 issue, page 38, there is an omission from the circuit of fig. 3. The feed to the Varicap diode CR_4 should be through a 22K resistor or the 0.001 feedthrough capacitor will short out the r.f. across L_1. The author has also suggested changing the value of the 1.6 mf capacitor, from the base of Q_{12} to ground, to 0.22 mf to provide a faster relay response.

In the Sept. issue on page 62 (People and Places), the upper left hand photograph is in error in that the recipient of the award is not Tom Appleby, W3AX. The photograph shows Leo C. Young, W3WV receiving QCWA's 50 year award.

The Oct. issue has an article on page 29 called "A Product Detector For The 75A-4." This should be 75A-3. The drawings for Fig. 1 and Fig. 2 are interchanged as noted by the captions.

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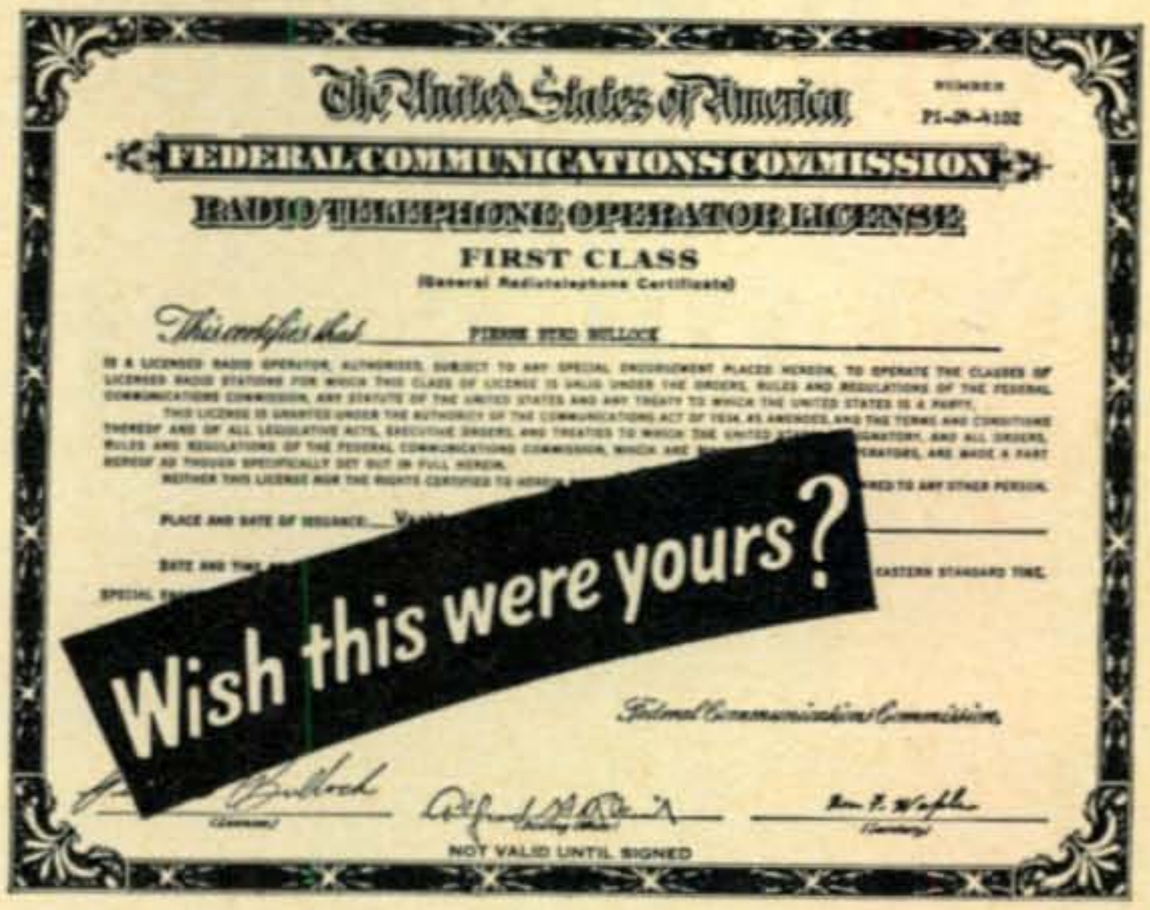

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For further information, check number 27, on page 110

A.M. For The Heathkit

SB-110 6-meter Transceiver

BY WILFRED M. SCHERER*, W2AEF

In our review of the Heathkit SB-110 6-meter s s b transceiver [1] mention was made that it could be used on a.m.; however, we neglected to point out that there are no built-in provisions for such operation. The equipment manual does not specify a.m. operation nor how it can be accomplished. As a consequence, many inquiries have been received on the matter, particularly since a.m. operation still is the predominant mode on the 50 mc band.

Our original method for providing a.m. type transmission using a single sideband with carrier (s.s.b.c.) was to unbalance the "balanced" modulator to provide the necessary carrier. This did not always work out, because the degree of available carrier was dependent on the proximity of the carrier-crystal frequency to the passband of the sideband filter. This was found to vary in some cases.

Besides this, received a.m. signals had to be demodulated with the product detector by zero-beating the a.m. carrier, but due to the fact that so many 6 meter a.m. signals drift, have low modulation or "fm" badly due to frequency instability with modulation, reception of such signals with the product detector was difficult. It thus became evident that envelope detection also should be provided for a.m. reception.

We therefore decided to work out a permanent modification whereby satisfactory a.m. type operation can be instantaneously obtained on both transmit and receive by switching from the panel, with the alterations made without "butchering" the equipment.

The modified circuitry is shown at fig. 1. At first glance it may appear complicated, but it actually is a simple arrangement that can be easily installed as described below.

References made to pictorial diagrams and their associated pages are those shown in the Heathkit SB-110 Assembly Manual.

*Technical Director, *CQ*.

[1] "*CQ* Reviews the Heathkit SB-110 6-meter S.S.B. Transceiver," *CQ* May '66, page 59.

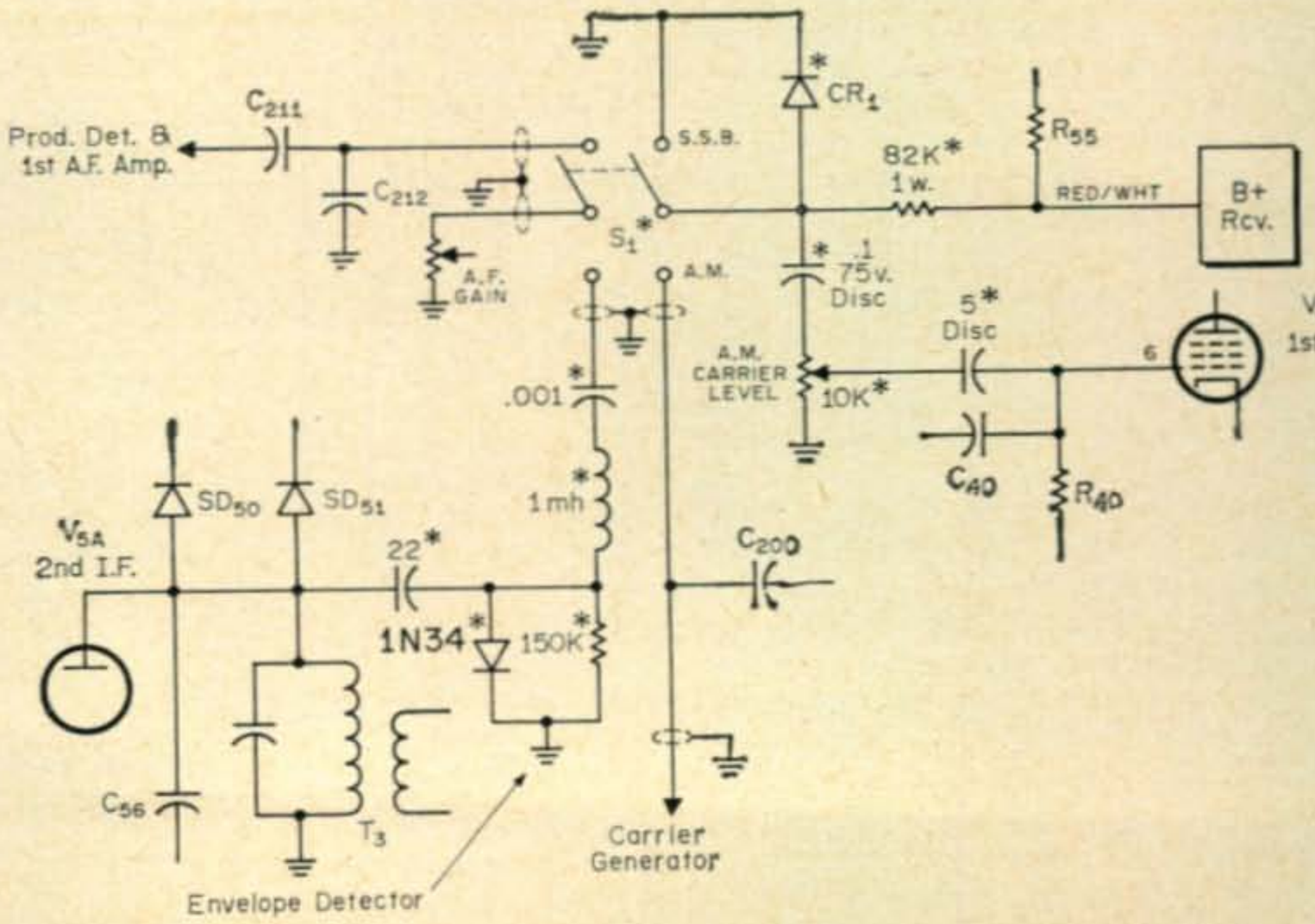


Fig. 1—Modified circuitry for a.m. transceive operation with the Heathkit SB-110. New parts are marked with an asterisk. The d.p.d.t. switch should be a slide type and one that operates easily and smoothly. CR_1 may be any type diode that has a very low forward resistance and a high back resistance (including silicon-rectifier types). The 1 mh r.f.c. is a miniature type, Millen 34300-1000 or J300-1000. Additional parts required are: approximately 5 feet of small diameter coax, two 4-terminal tie strips, one 2-terminal tie strip, one piece of aluminum 3" × 3½" × 1/16", one foot of #14 bussbar or wire from a coat hanger, one 7/16" diameter cone-shaped knob, Heathkit part No. 462-175.

In the first three steps, apply heat with a soldering iron at the indicated points on the bottom of the receiver i.f. board and push the designated lead so that it protrudes ⅛"-¼" above the top side of the board (additional insulation might have to be removed from each lead in order that it also will remain soldered to the board foil).

☐ 1. Pictorial 3-16, page 50—Point A, either red-white wire.

☐ 2. Pictorial 3-17, page 51—lead from 0.005 mf disc capacitor at point T.

☐ 3. Pictorial 3-24, page 58—inner lead from red coax cable at point 1 and its shield connection also.

☐ 4. Mount a two-terminal tie strip, TSB, as shown at fig. 2. Fasten it with the middle screw that holds the variable tuning capacitor that is located above the chassis. Do not connect leads to TSB at this time.

☐ 5. Solder components to a four-terminal tie strip, TSA, as shown at fig. 3. Do as much of the work as possible before mounting the tie strip. Do not install the 0.005 disc capacitor at terminal 1 until later, as indicated in step 19.

☐ 6. Mount tie strip TSA underneath the chassis using the screw and nut that fasten the i.f. board at the indicated point.

☐ 7. Solder the free end of the 22 mmf disc capacitor to point *X* at the base of the noise-limiter board. (See fig. 3 and pictorial diagram 1-8, page 12.)

☐ 8. Drill two holes for 6-32 screws (#26 drill) in the left side brace of the SB-110 as shown at fig. 4(A).

☐ 9. Bend and drill a bracket as shown at fig. 4(B).

☐ 10. With the bottom of the bracket resting on the edge of the top side of the i.f. board and held by hand against the SB-110 side brace (opposite T_2-V_3), mark the bracket to match the holes just drilled in the side brace. Then drill #26 holes at the points marked on the bracket.

☐ 11. Drill a 1/16" diameter hole crosswise through the lever of a d.p.d.t. slide switch.

☐ 12 Mount the slide switch, a 10K potentiometer and a four-terminal tie strip, TSC, on the bracket as shown at fig. 5.

☐ 13. Connect and solder components and leads as indicated at fig. 5. Solder the diode (*CR*1) in place last, making sure to connect the cathode end as shown.

☐ 14. Mount the bracket to the SB-110 side brace using 6-32 screws and nuts.

☐ 15. Route leads *C*, *D* and *E* along the top edge of the receiver i.f. board, under the meter and through the rubber grommet under the left dial lamp. The leads will be connected later.

☐ 16. Solder lead *B* to the protruding lead on top of the i.f. board at point *A*. (See step 1.)

☐ 17. Solder the inner conductor of lead *A* to the lead protruding on top of the i.f. board at 1. (See step 3.) Also, solder the shield of lead *A* to the protruding shield connection of the cable at 1.

☐ 18. Solder the free end of the 5 mmf disc

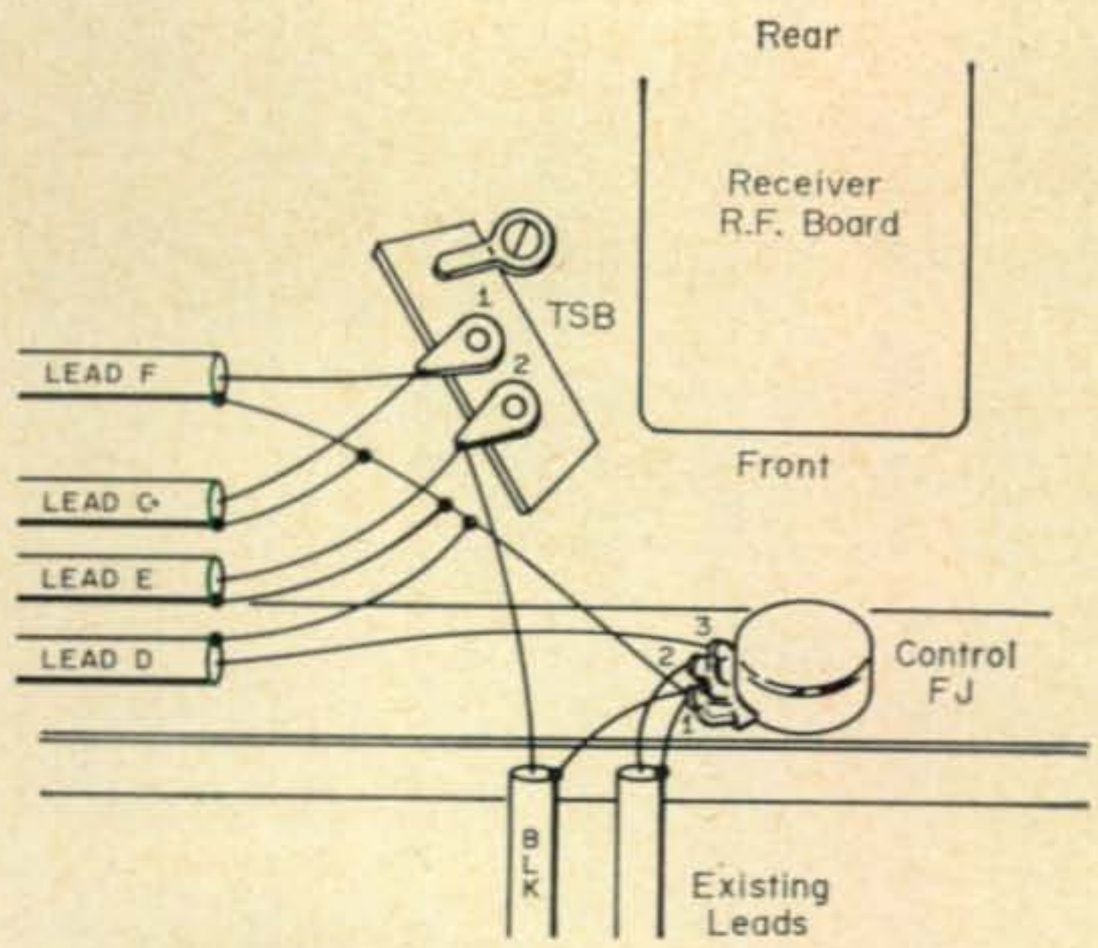


Fig. 2—A.f. shielded connections on tie strip TSB and control FJ. Dress lead F towards rear of rec. r.f. board.

capacitor to the lead of the 0.005 mf capacitor that protrudes above the board at point *T*. (See step 2.) Route the capacitor leads so that they easily clear the shield of V_3.

☐ 19. Pictorial 3-19, page 53—remove the 0.005 disc capacitor leads from the solder lug and terminal 3 at control FJ. Solder one lead of the capacitor to the underside of the i.f. board at point 2, as identified in Pictorial 3-24, page 58. Solder the other lead of the capacitor to terminal 1 on TSA as shown at fig. 3.

With steps 20-25 also refer to Fig. 2.

☐ 20. Pictorial 3-25, page 59—remove inner lead of the black coax cable from terminal 3 on control FJ and connect it to terminal 2 on TSB (NS).

☐ 21. Connect inner conductor of lead *F* (from terminal 4 of TSA) to terminal 1 on tie strip TSB (NS). The cable shield is not to be connected at this time.

☐ 22. Connect inner conductor of lead D (from terminal 5 of the new slide switch) to terminal 3 on control FJ (S). Do not connect shield at this time.

☐ 23. Connect inner conductor of lead E (from terminal 6 on the slide switch) to terminal

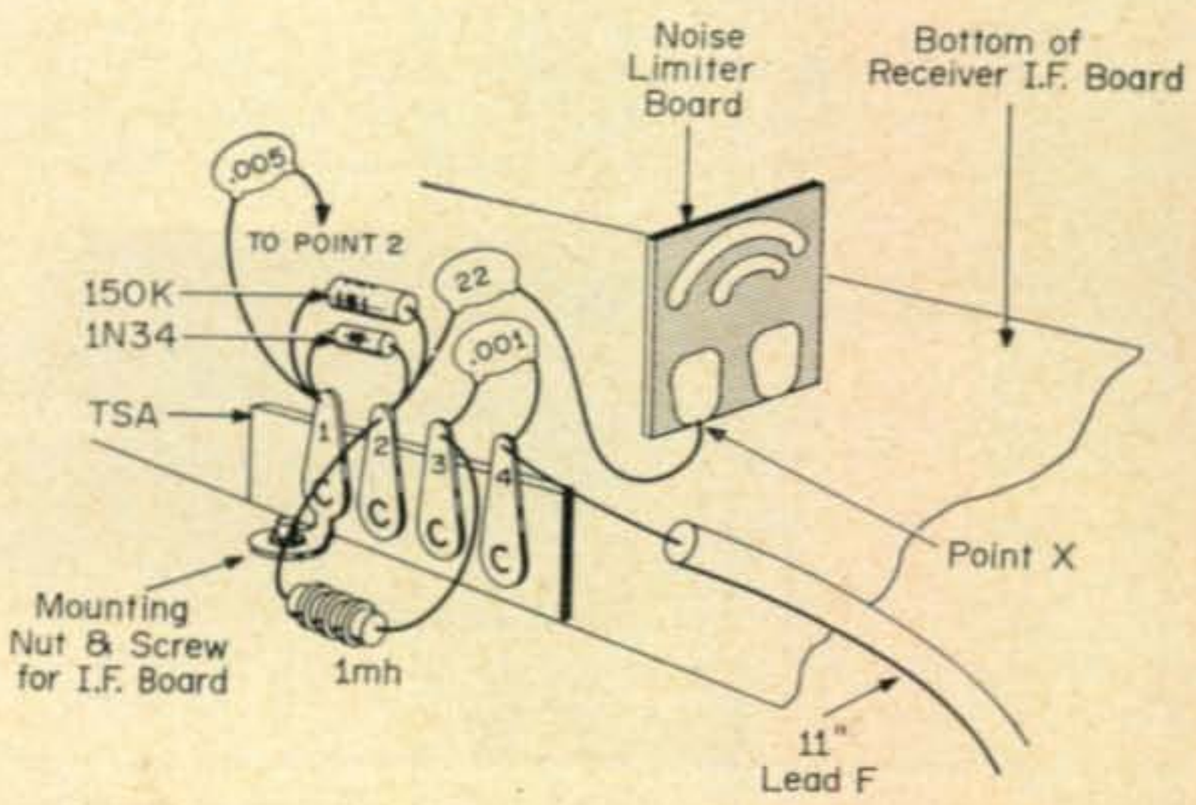
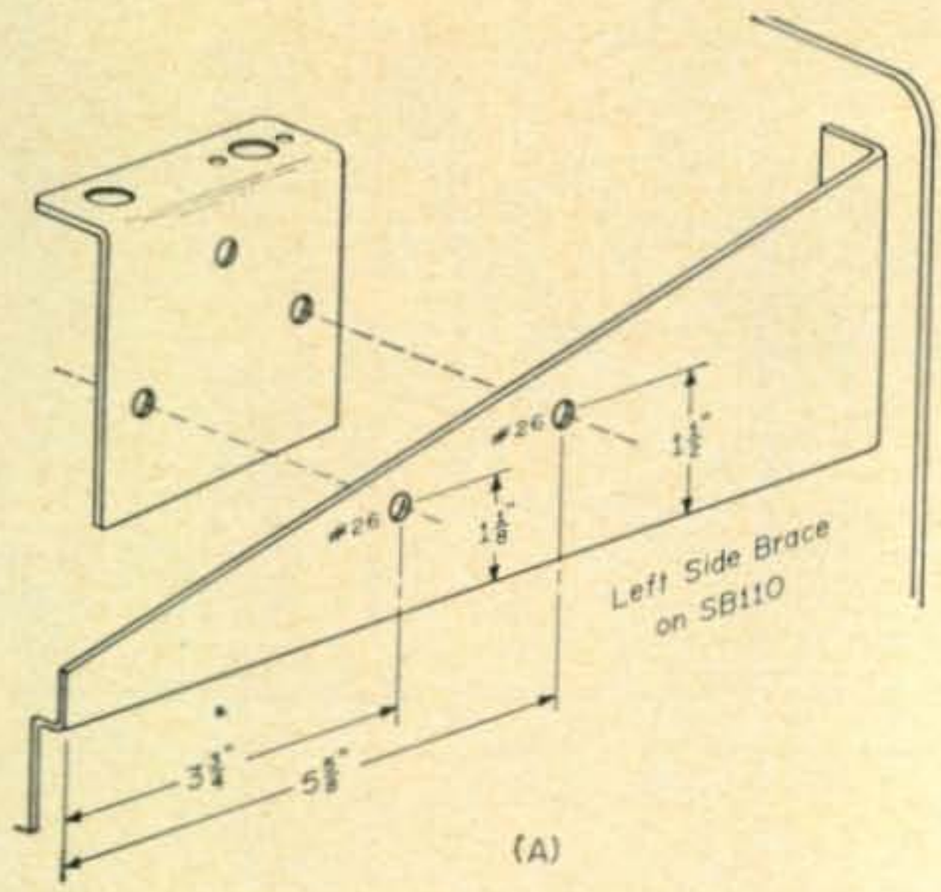
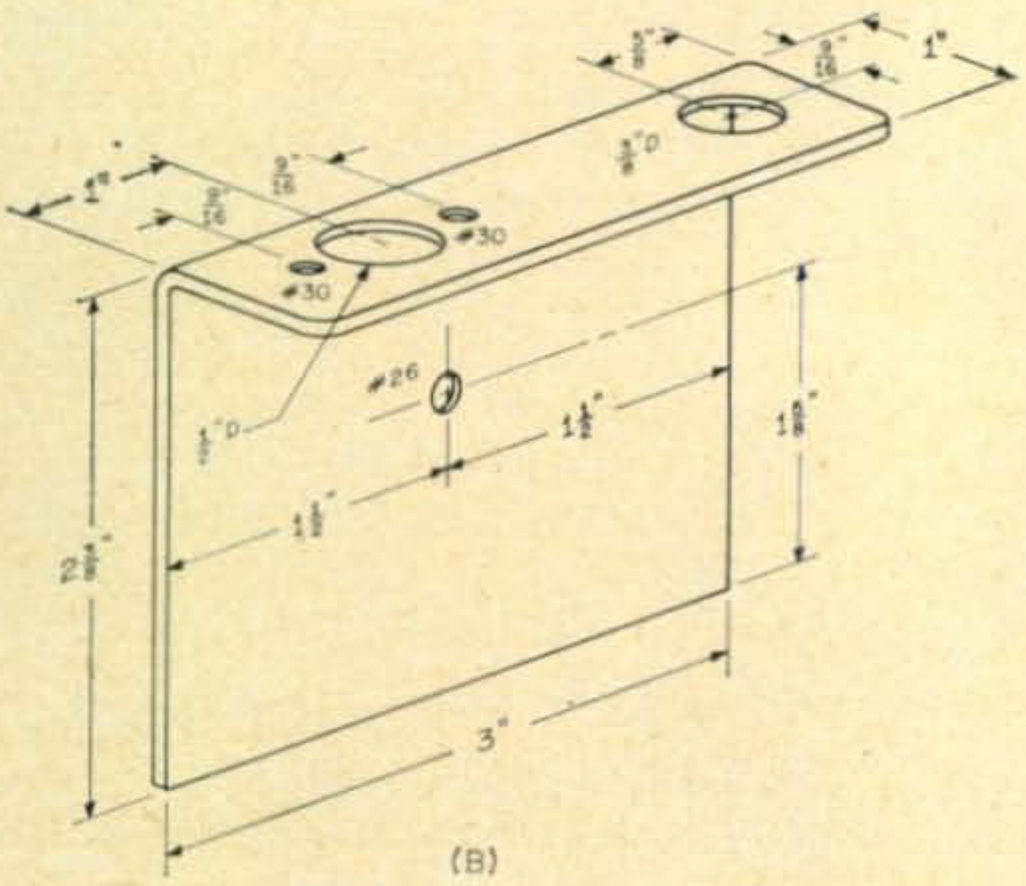


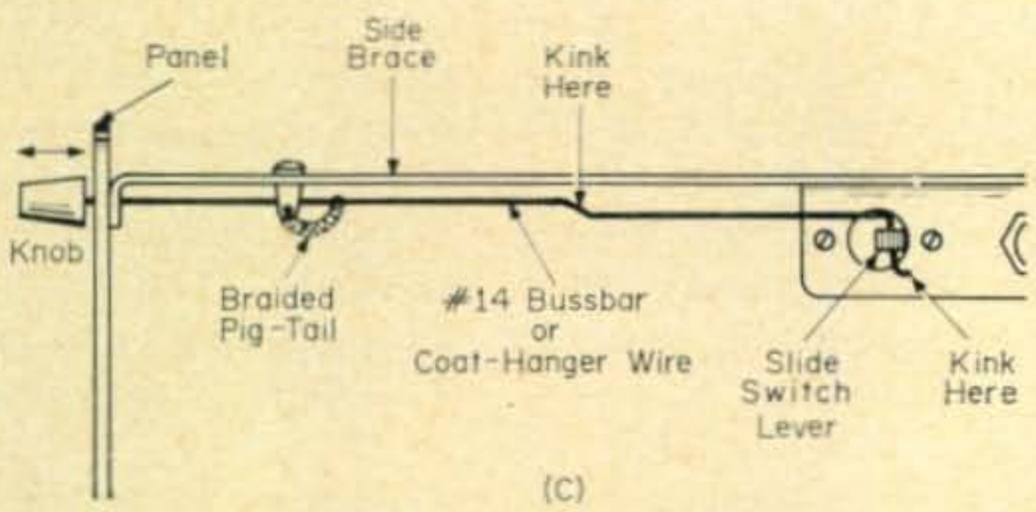
Fig. 3—Components for envelope detector as assembled underneath receiver i.f. board.



(A)



(B)



(C)

Fig. 4(A)—Dimensions for holes to be drilled in left side brace of the SB-110. Also drill a hole 1⅞" from the panel and 3" from the bottom of the side brace (for step 30). (B)—Dimensions for bending and drilling bracket to be mounted on side brace as shown at (A). (C)—Method of linking the switch lever with bussbar.

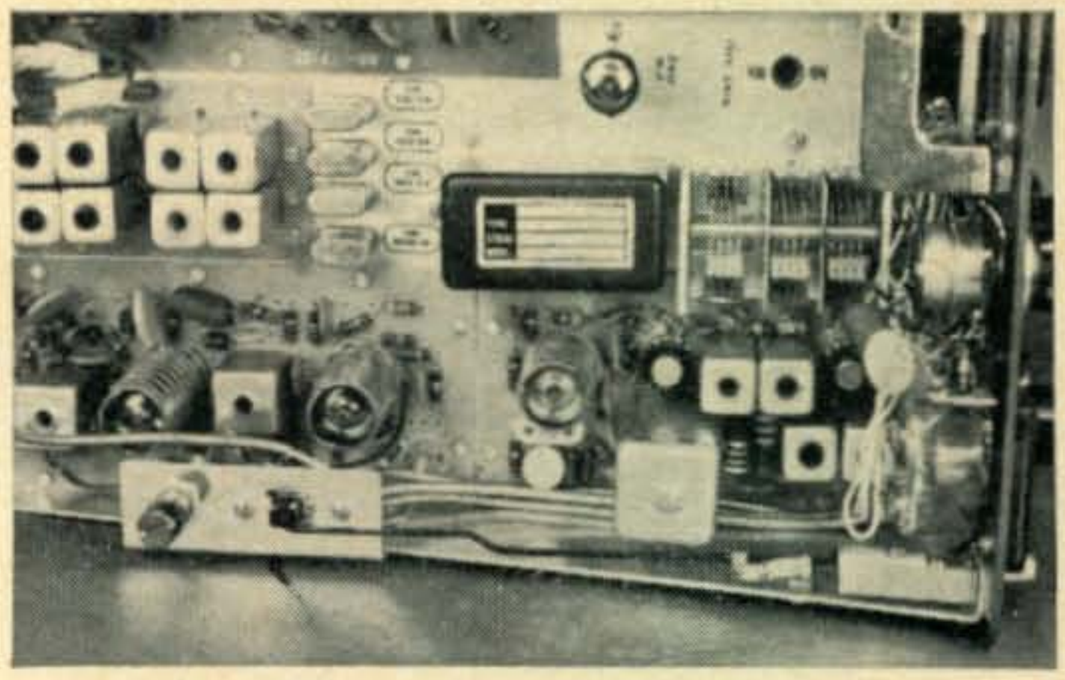
2 on tie strip TSB (S). Do not connect shield yet.

☐ 24. Connect inner conductor of lead C (from terminal 4 of the slide switch) to terminal 1 on tie strip TSB (S). Do not connect shield yet.

☐ 25. Connect shield leads from all the cables together and to terminal 1 on control FJ (S).

☐ 26. Drill a 1/16" diameter hole in the SB-110 panel at the left of the meter, locating it 5/8" from the left edge of the panel and 1½" from the top.

☐ 27. At one inch from one end of a 12" piece of #14 bussbar (or a piece of coat-hanger wire), bend the bussbar to form a right angle. From the rear of the panel, slide the other end of the bussbar through the panel hole.



Topside view of the SB-110 showing the completed modifications along the bottom edge. The bracket is to the left with the bussbar link running to the front panel on the right.

☐ 28. Referring to fig. 4C, slip the right-angle end of the bussbar through the hole in the slide-switch lever. Make a slight kink near the middle of the bussbar so that each half lines up evenly with the switch lever and the side brace of the set. Kink the end of the wire so it will not slip out of the lever, taking care not to exert pressure that may split the lever (instead of the kink, you can place a glob of solder at the end of the wire).

☐ 29. At the front of the panel, cut off all but about ½" of the bussbar and mount the cone-shaped knob referred to in fig. 1.

☐ 30. Drill a #26 hole near the top and toward the panel-end of the SB-110 left side brace and fasten a solder lug at this point.

☐ 31. Solder a flexible "pigtail" (made of a piece of braided shield from coax cable) between the solder lug and a nearby point on the bussbar.

This completes the modification.

Operation

A.m. type transceive operation is obtained by pulling the A.M. knob out; the s.s.b. mode is restored by pushing the knob in. The procedure for setting up a.m. is as follows:

☐ 1. With the A.M. knob *pushed in* (s.s.b. position), tune up the SB-110 in the normal manner for maximum output.

☐ 2. Note the relative output-power reading on the meter.

☐ 3. Set the *mode* switch at either LSB or USB.

☐ 4. *Pull out* the A.M. knob.

☐ 5. With the FUNCTION switch set for PTT, press the push-to-talk mic button and adjust the internal CARRIER-LEVEL control (located on the newly installed bracket) for a relative power-output reading equal to *half* that noted during tuneup.

[2]The bussbar should pass perpendicularly through the panel.

Front view of the top left corner of the SB-110. The new push-pull control can be seen to the left of the meter. The matching knob is Heathkit part No. 462-175. Decals add the finishing touch.

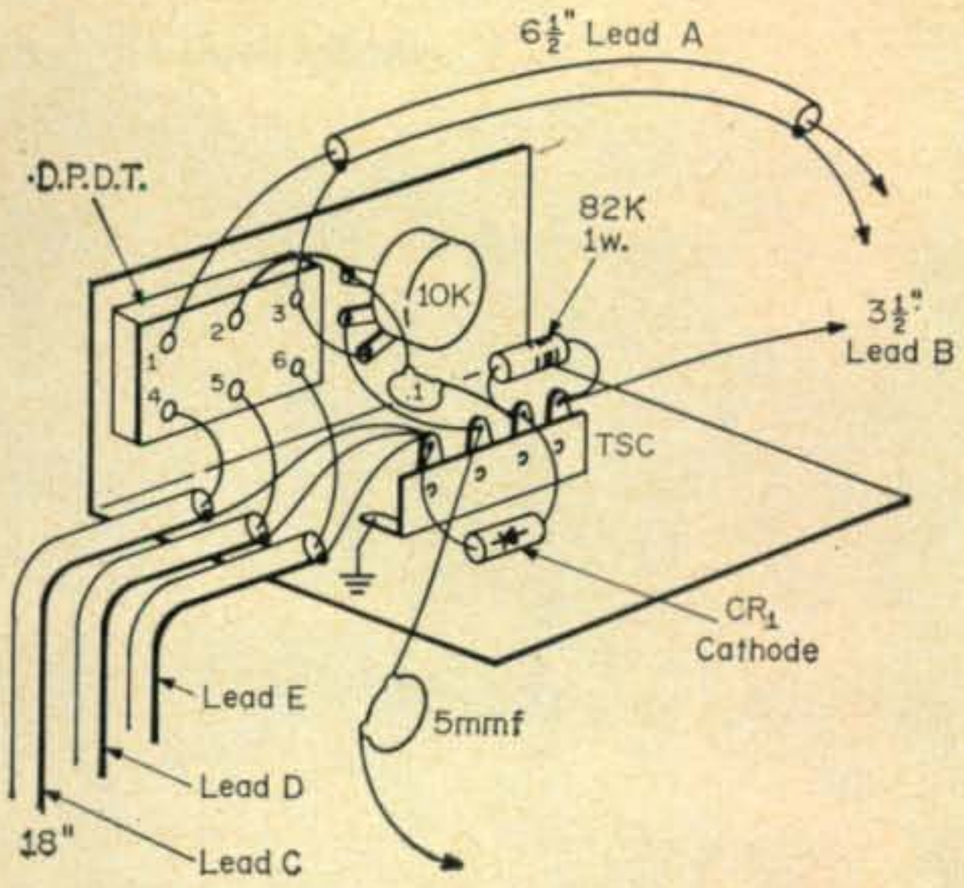


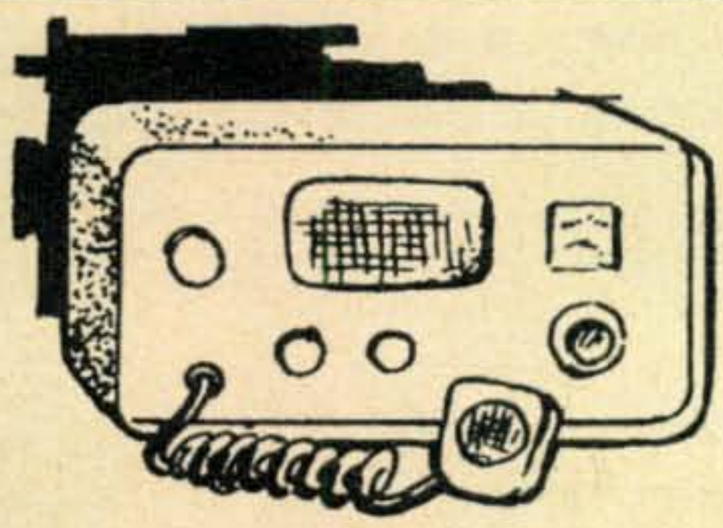
Fig. 5—Bottom view of side bracket showing installation of components and leads.

☐ 6. Adjust the MIC GAIN so that with voice the relative-power meter kicks upward very slightly. You're now on the air with a.m. or s.s.b.c. (25 watts carrier output, 100 watts p.e.p.).

A.m. signals may be received normally; however, due to the narrow bandwidth of the sideband filter, the signals will be quite sharp to tune and some loss of high-frequency a.f. response may be experienced. The latter can be minimized a bit by tuning slightly to one side of the passband. Reception of the s.s.b.c. signal also is best obtained when the receiver is tuned to one side of the signal, or close to the carrier frequency.[3] [4]

[3]It also should be kept in mind that the tranceive operation puts both the receiver and the transmitter on the same frequency. If you call CQ and a reply is received on another frequency, you'll have to tune back to the original frequency and tell the calling operator that you'll then QSY to his frequency, in which case the QSO can then be conducted without your having to tune back and forth between transmit and receive.
[4]The noise limiter is designed only for s.s.b., and thus may introduce distortion on a.m.

[*Continued on page 103*]



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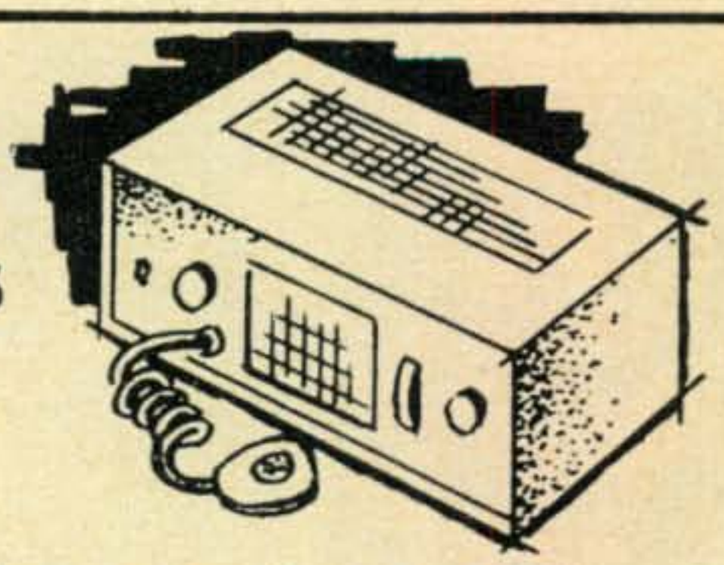

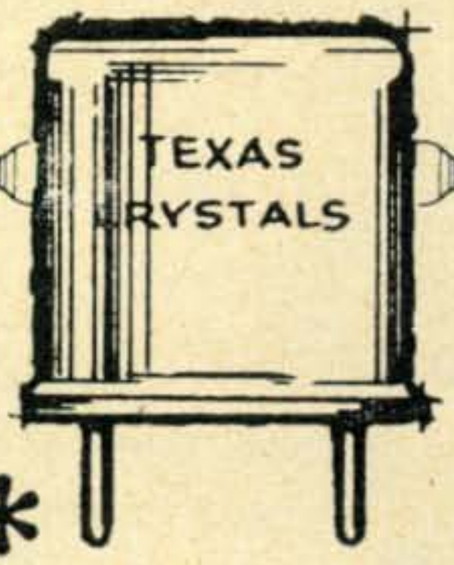

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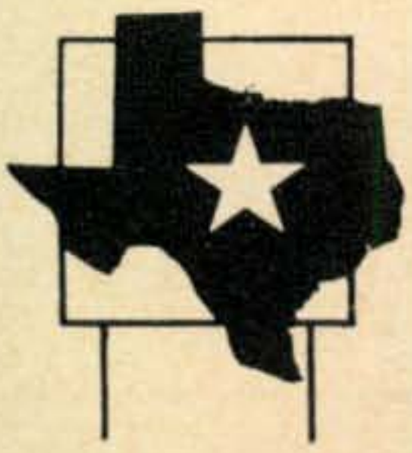

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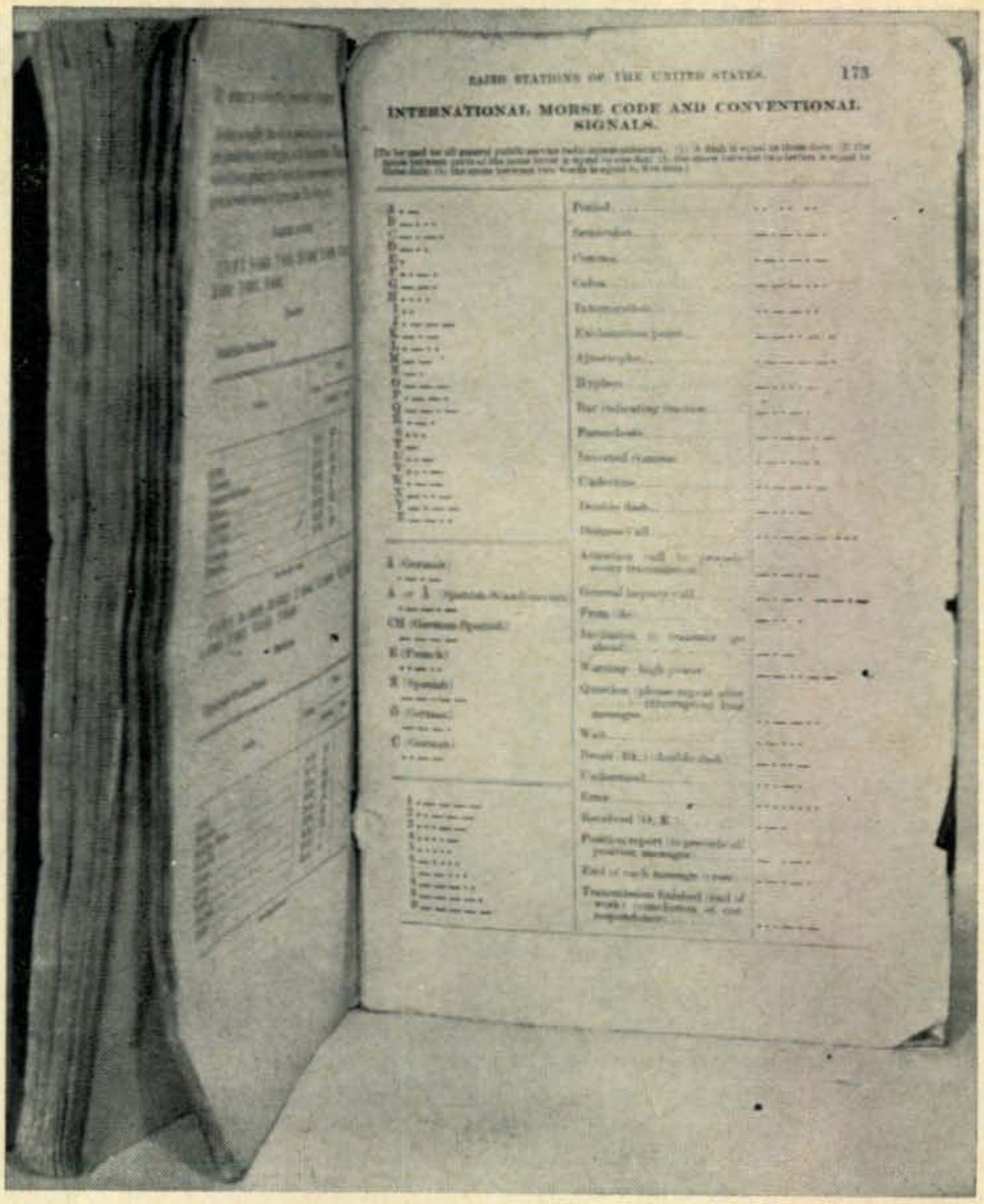
For further information, check number 55, on page 110

Take your magnifying glass and cast your eye on the right hand lower corner of this page from the past . . . a 1913 Official U.S. Government Callbook. Good old "30" from the Morse days receives official approval by the familiar . . . — . — (SK).

"30" AGAIN



BY HOWARD S. PYLE,* W7OE

IN a past issue of *CQ* an explanation of the meaning of 'thirty' in ending a published article as used by some magazine publishers was offered, crediting its' origin as a finish breakhead to the publishing industry; it goes back much farther than that!

Long before the introduction of "wireless" as a communication method, Morse telegraph operators had readily adopted the expression to indicate the end of a communication over telegraph wires. Why this combination of characters was chosen remains a mystery but in all probability it was the rhythmic and easily recognizable character of the group in the telegraph code, just as with "SOS" in the radio code, that influenced its' adoption.

In the Morse (land-line) telegraph code, the figure three is represented by three dots, a dash and a dot thus: • • • — •. Zero consists of a long dash. The combination of the two characters then, when run together, came out "dit dit dit dah dit d-a-a-h"; (• • • — • ———). Say this fast to yourself; you'll catch the rhythm.

With the establishment of "wireless" telegraphy at the turn of the century this practice was continued, as early wireless messages were exchanged in the American Morse code. A large proportion of the pioneer wireless operators were recruited from the travel-hungry and adventurous among the Morse telegraph operators. It was only natural that they carried all of the operating techniques of Morse wire telegraphy with them when they went to sea or served as wireless operators at early day shore stations. No laws had then been established governing wireless communication consequently message format and other communication exchanges merely took the forms to which the former Morse telegraphers had become accustomed. The Ship Act enacted by Congress in 1910 took only cursory notice of operating procedures evidently preferring to 'let it ride as was' as long as satisfactory communication was being conducted.

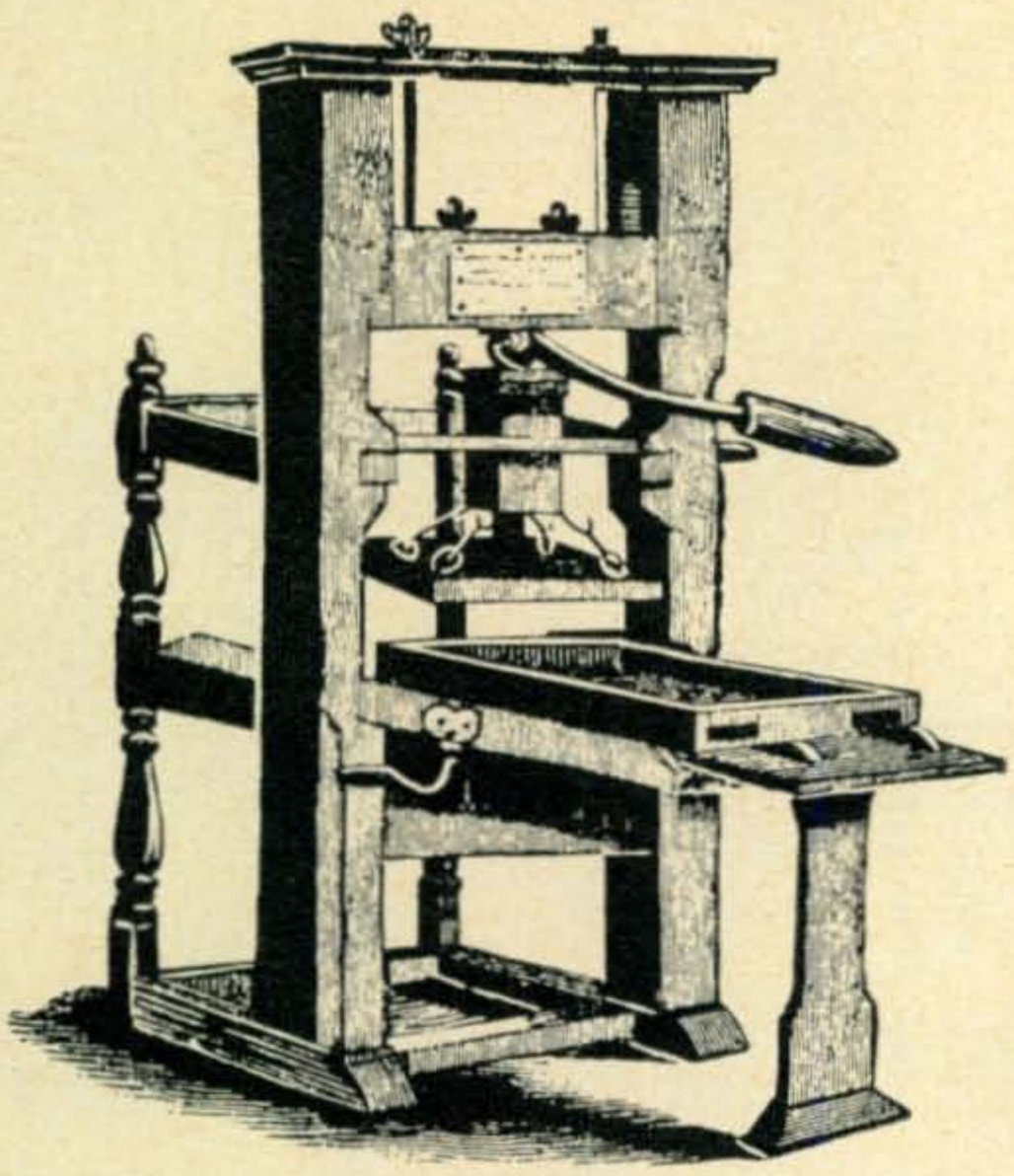
As telegraphic press service had by then been established, Morse telegraphers had been assigned to various newspaper offices to handle such wire communications . . . the expression '30' went with them of course. Reporters in close contact with the press telegraphers were quick to pick it up as a finish designator for their news copy; it infiltrated into editorial offices and soon became one of the standard, informal indicator signs of the publishing business.

With the enactment of the Radio Law of 1912 by the Congress, the apple cart was a bit upset as the new law called for the abandonment of the American Morse code and adoption of the International code. (Often called 'Continental'

[*Continued on page 103*]

*3434—74th Ave., S.E., Mercer Island, Wash., 98040.

USEFUL BOOKS FOR THE AMATEUR



PERIODICALLY we are questioned here as to suggestions for books for the amateur, both advance and beginner. Generally the requests are on specific topics regarding basic electronics not covered in the handbooks. We are also asked to suggest books to people interested in becoming hams and who want to learn more than is required to get a license. With all due deference to the wealth of material already available, we present a list of publications from the U.S. Government Printing Office which are useful to the beginner and can be handy reference guides to those already advanced in electronics.

To order the books, just send the correct amount of money to: Superintendent of Documents, Government Printing Office, Washington, D.C., 20402. The books are sent postpaid within the U.S. Be sure to include correct catalog numbers.

Introduction to Electronics. This Navy Training Course discusses power supplies and how they operate to produce the voltages necessary for the operation of electron tubes and control circuits; electron tubes and how they are used in amplifier and oscillator circuits; electron tubes and how they are used in amplifier and oscillators; the basic principles of radio, radar, and sonar systems; and presents an elementary treatment of servosystems which emphasizes the basic operation and some common applications of servosystems as they are used in monitoring and control circuits. 1963. 149 p. il.
Catalog No. D 208.11:1 2/16 75¢

Basic Theory and Application of Electron Tubes. A Defense Department training manual, this study is concerned with the theory, development, and use of the electron tube. It discusses the varied uses of electron tubes in communications equipment and describes their construction and component parts, types, and operation. Among the features examined are diodes, triodes, electron emission, multi-electrodes, amplification, and oscillators. 1952. (Change 1, November 1955 and Change 2, April 1958, inserted.) 215 p. il.
Catalog No. D 101.11:11—662 $1.25

Basic Electronics. Presenting many of the basic concepts in the field of electronics, this Navy Training Course begins with a discussion of electron tubes, followed by their action in power supplies, amplifiers, and oscillators. It then discusses tuned circuits as applied to band-pass and band-stop filters and to inductively coupled circuits, modulation, detection, transmitters, receivers, antennas, and radio wave propagation. The text concludes with a discussion of electronic-test equipment, an introduction to radar, introduction to transistors, and digital computers. Included in the appendixes is a listing of training films that are directly related to the information in this training course, and information on electronic color coding and symbols. Rev. 1962. 471 p. il.
Catalog No. D 208.11:El 2/10/962 $2.75

Basic Theory and Application of Transistors. Following a general discussion on transistors and a description of the fundamental theory of transistors, this Army technical manual includes data on transistor amplifier fundamentals; parameters, equivalent circuits, and characteristic curves; bias stabilization; transistor analysis and comparison; audio, tuned, and wide-band amplifiers; oscillators; pulse and switching circuits; modulation, mixing, and demodulation; and additional semiconductor devices. The manual is designed for the electronic technician who has a detailed knowledge of the theory and application of electron tubes. 1959. 263 p. il.
Catalog No. D 101.11:11—690 $1.25

Fundamentals of Electronics. This publication is unique in that it does not require the reader to accept technical principles as unrelated facts to be committed to rote memory. It explains the "why" of electrical/electronic principles and "how" these principles can be applied to circuits and equipment to develop competence in technical knowledge and skill. To insure understanding has been accomplished, questions which require the reader to apply information he has just learned are inserted after each group of related paragraphs throughout each chapter. The 8 volumes which make up this publication *are listed below.*

Vol. 1. Basic Electricity. 1964. 362 p. il.
Catalog No. D 208.11/2:El 2/9/v.1 $2.75

Vol. 2. Power Supplies and Amplifiers. 1964. 156 p. il.
Catalog No. D 208.11/2:El 2/9/v.2 $1.75

Vol. 3. Transmitter Circuit Applications. 1964. 138 p. il.
Catalog No. D 208.11/2:El 2/9/v.3 $1.50

Vol. 4. Receiver Circuit Applications. 1964. 200 p. il.
Catalog No. D 208.11/2:El 2/9/v.4 $2.00

Vol. 5. Oscilloscope Circuit Applications. 1964. 133 p. il.
Catalog No. D 208.11/2:El 2/9/v.5 $1.50

Vol. 6. Microwave Circuit Applications. 1964. 123 p. il.
Catalog No. D 208.11/2:El 2/9/v.6 $1.50

Vol. 7. Electromagnetic Circuits and Devices. 1964. 81 p. il.
Catalog No. D 208.11/2:El 2/9/v.7 $1.50

Vol. 8. Tables and Master Index. 1964. 162 p. il.
Catalog No. D 208.11/2:El 2/9/v.8 $1.75

Theory and Use of Electronic Test Equipment. This Army technical manual describes the theory and use of nearly every important radio test instrument, such as multimeters, vacuum-tube voltmeters, signal tracers, tube checkers, and other devices used to locate electronic trouble. 1952. 158 p. il.
Catalog No. D 101.11:11—664 75¢

Electronics Technician 3. Prepared for the use of naval personnel, this Navy Training Course should also prove to be of use to others interested in studying to become an electronics technician. Its chapters include brief descrip-

tions of various types of electronic equipment; and information on safety precautions; component and equipment nomenclature and designations; test equipment; switches, switchboards, and switching systems; common operating adjustments for radio transmitters and receivers, teletype and facsimile, radar and loran equipment; and maintenance procedures and techniques. 1963. 402 p. il.
Catalog No. D 208.11:El 2/5/963 $2.25

Transistors and Printed Circuits. Prepared to provide Navy personnel with a working knowledge of the different types of transistors, how they work, and how they are used, this training course should also prove of value to others interested in learning about transistors and printed circuits. Following an introduction to transistors, the course deals with semiconductor basic circuits, transistor circuit applications, printed circuits, and description of training device circuits. The first volue is for the trainee, the second for the instructor.

Transistors and Printed Circuits, Information, Experiments and Applications [Trainee's Guide]. 1962. 178 p. il.

Catalog No. D 208.11/2:T 68/962 $1.75
Transistors and Printed Circuits, Instructor's Guide for Maintenance Technician Training. 1962. 102 p. il.
Catalog No. D 208.11/2:T 68/2/962 $1.75

Basic Electricity. One of the Navy Training Course series, this book discusses the fundamental concepts of electricity, covering such subjects as direct-current circuits; electrical conductors and wiring techniques; magnetism and magnetic circuits; direct-current generators and motors; alternating-current circuit theory with the use of vectors and sine curves, wherever possible; and a treatment of alternating-current generators, transformers, motors, indicating instruments, and synchros. 1960, published 1961. 448 p. il.
Catalog No. D 208.11:El 2/3/960 $3.50

Selected Semiconductor Circuits. This comprehensive Navy handbook provides the transistor circuit engineer with a reference of reliable, well-designed examples of contemporary circuits. To make this a valuable handbook in years to come, when the selected circuits may have been outdated, the design philosophies included with each part have been given great emphasis. The areas of current generators and motors; alternating-current circuit theory with amplifiers, high-frequency amplifiers, oscillators, switching circuits, logic circuits, a.c. to d.c. power supplies, power converters, and small signal nonlinear circuits. 1960. [444] p. il.
Catalog No. D 7.6/2:215 $2.25

Radio-Frequency Power Measurements. Presents a comprehensive survey of methods used to measure radio-frequency power. The methods covered are classified according to their theoretical origin, and the theoretical background, practical limitation, and advantage of each method are discussed briefly. 1953. 16 p. il.
Catalog No. C 13.4:536 20¢

Troubleshooting and Repair of Radio Equipment. A practical reference guide to the troubleshooting and repair of radio receivers and transmitters. Providing broadly general procedures and methods for troubleshooting, this Army manual contains chapters on test equipment; general troubleshooting; troubleshooting vehicular installations, receivers, AM and FM transmitters; receiver alinement; repairs and adjustments; radiac procedures; troubleshooting transistorized equipment; and repairing printed wiring assemblies. 1958. 177 p. il.
Catalog No. D 101.11:11—4000 $2.00

The World's Most Active Radio Club

BY GEORGE JACOBS,* W3ASK

Most amateur radio clubs meet monthly, some more active ones meet weekly, but in Helsinki, Finland, the members of the Café de Colombia Radio Club meet every weekday, and they have been doing this for the past sixteen years!

The meetings, which are called to order at exactly 12 noon, are held in the Café de Colombia (hence the club's name), located at the corner of Aleksanterinkatu and Mikonkatu streets in the heart of downtown Helsinki. Lasting about an hour, the meetings combine luncheon with amateur radio talk. About a dozen of the local radio amateurs are at each meeting, and often there are visiting radio amateurs from other parts of the world.

The Club, formed in 1950 by 18 local radio amateurs, now has world-wide membership. Finnish radio amateurs can join by working ten members of the Club on any amateur band, using any mode of transmission. Applications for membership by Finnish radio amateurs must be submitted personally at a Club meeting. There are over 100 Finnish members at the present time. Foreign radio amateurs can join by working five members of the Club in any country, and submitting a certified log extract by mail to the Club for "correspondent" membership, or in person at a Club meeting for "foreign" membership. At the present time there are over 100 correspondent members and nearly 50 foreign members.

There are no dues or membership fees for the Café de Colombia Radio Club, but by tradition,

[*Continued on page 102*]

A typical gathering at the daily meetings (weekdays) of the Café de Colombia Radio Club, Helsinki, Finland. Shown in the photo are OH2MH, BQ, YW, YV, TK, TM, XA, QI, and OH5NQ.

*11307 Clara Street, Silver Spring, Md. 20902.

STABILIZING THE NC-101X

BY ARTHUR C. ERDMAN,* W8VWX

The techniques applied to stabilizing the local oscillator of the NC-101X can be used to improve other unstable receivers.

WHILE the basic circuits discussed in this article will apply to any receiver, tracking problems are avoided when applied to a ham-band-only receiver. The usual method of frequency stabilization for an old receiver (besides trading it in) is to use the lowest range of the receiver as a tunable i.f. amplifier and use crystal-controlled converters. I have tried crystal-controlled converters and have found them satisfactory. However, just out of plain curiosity, I was interested in finding out how much stability was possible at 14 mc with an ordinary tunable 14 mc local oscillator and the usual 455 kc i.f. amplifier arrangement.

The receiver I stabilized was a very drifty NC-101X. (A 28 year old National Radio receiver with an HRO type PW dial.) From a cold start to a four hour warm-up, this receiver drifted 25 kc at 14 mc. In fact, the drift never stopped. At the end of two days of continuous operation the receiver still drifted enough that c.w. signals had to be retuned at the beginning and during each listening period.

Criteria

As a c.w. operator, my criteria for good receiver stability are these:

*241 Garden Road, Columbus, Ohio.

Band	mmf C_1	mmf C_2	mmf C_3
160	20	770	770
80	25	580	580
40	30	470	470
20	20	174	174
10	50	75	157

Table I—Capacitance values used in the local oscillator.

1. After a half hour warm-up, the c.w. signal should not need any retuning for at least twenty minutes of a QSO. In other words, during two ten-minute exchanges there should be no need to hunt for the other guy.
2. The c.w. tone should not be noticeably affected by variation in line voltage or r.f. gain setting.

Modifications

To achieve these results here is what was done:

1. The local oscillator tank circuit arrangement was changed to reduce drift due to tube capacitance drift.
2. The new tank circuit requires a tube with greater transconductance. A nuvistor, 6CW4, was chosen because it has a very high transconductance and is non-microphonic.
3. A cathode follower was added between the local oscillator and the mixer.
4. A vr tube was added for the local oscillator and the cathode follower.

The first two modifications reduce the frequency shift over the long periods, while the last two modifications reduce the drift over the short time periods. Changes in line voltage and changing the R.F. GAIN control have no noticeable affect on the c.w. pitch.

Figure 1 shows the typical local oscillator circuit and fig. 2 shows the modified circuit which immediately improves the frequency stability.

The original circuit has only about 25 mmf as the total capacitance across the tank inductance. With such a low value, minor changes in tube capacitance with heat or vibration caused the poor stability. If the wire that led to the grid cap of the original local oscillator tube (6J7) was moved to a different position, the frequency

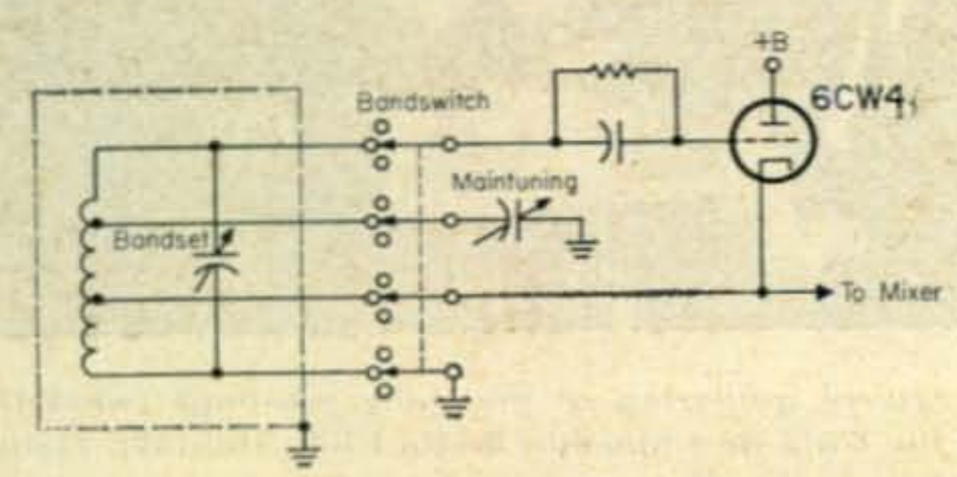


Fig. 1—Typical local oscillator circuit of a ham-band only receiver.

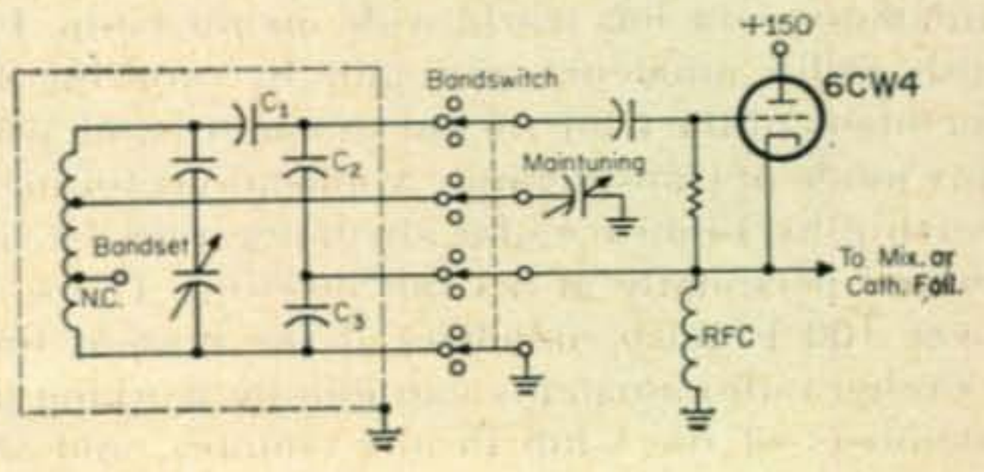


Fig. 2—Improved local oscillator circuit that reduces drift but does not disturb oscillator tracking.

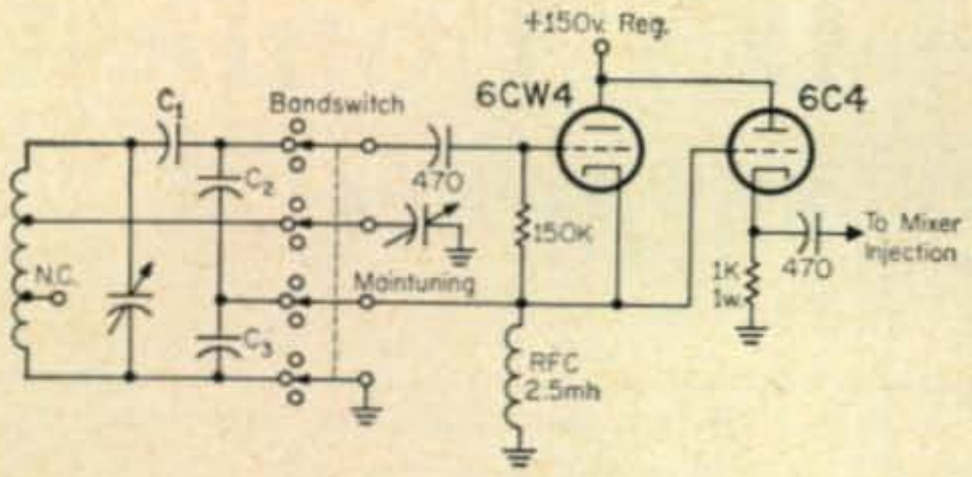


Fig. 3—Complete circuit of the modified local oscillator and cathode follower. The values of C_1, C_2 and C_3 are found in Table I.

shifted about 10 kc. In the modified circuit, the tube capacitances shunt much higher values of capacitance. The usual Clapp oscillator was not used because a slightly higher value of inductance is needed. This would upset the tracking. However, with this modified circuit, the feedback is reduced. The 6CW4 has enough transconductance to overcome the feedback loss and still have C_2 and C_3 fairly high in value.

Rather than put in a nuvistor socket on the chassis, I chose to mount a nuvistor inside an old metal octal-based tube. I destroyed a metal 6J5 by prying the metal from the octal base. If you have the correct kind of soldering pot, you can heat all the pin connections at once and easily remove the tube from its base. The insides of the tube are then knocked out. A nuvistor socket was then soldered to stiff wires that were in turn soldered to the proper octal pins. The 6CW4 is placed in its socket and the old shell of the 6J5 is placed over the whole unit. (A ground wire is also soldered to the shell.) The old 6J5 is now a 6CW4 and should be so marked. Replacing tubes is not much of a chore because the shell is simply press-fitted to the octal base and can be removed.

Component Values

Because your particular receiver will certainly not be an NC-101X, here is the experimental procedure used to determine the correct capacitor values:

1. Determine the capacitance to which the bandset capacitor has been originally set. I unsoldered the wire to bandset capacitor and measured the capacitance using a Direct Reading Capacity Meter[1]. For example, at 3.5 mc the measured capacitance was 35 mmf. Then turn bandset capacitor to its minimum capacitance and make another measurement. This was about 10 mmf.

2. The difference between these two capacitances determines the maximum capacitance that can be placed across the tank without disturbing the tracking. In this example ,the difference was 25 mmf. Therefore, C_1, C_2 and C_3 in series should not have more than 25 mmf total capacitance.

3. As a good first trial, C_1 is made equal the difference capacity mentioned above.

4. Capacitors C_2 and C_3 are then made equal (if possible) and as large in value that will maintain oscillations.

5. Realignment is very simple. Simply readjust the bandset capacitor so the dial setting corresponds to the original calibration. For example, if 3500 kc was at O on the dial, readjust the bandset so 3500 kc falls at O. The original tracking will be preserved.

Silver mica capacitors were used to avoid further drift problems. Table I shows the values used to cover the various ham bands when the local oscillator is 455 kc higher than the received signal. I used surplus capacitors which accounts for the odd values. If you are duplicating the circuit, use the nearest standard value. (Pick the nearest value on the low capacitance side.)

Temperature Compensation

Of course, exceptional frequency stability cannot be expected unless adjustable temperature compensation is used. However, without any deliberate temperature compensation added, the drift is now within the limits I set as acceptable.

The complete local oscillator schematic is shown in fig. 3. Now, the 20 meter c.w. signals have the same clear ring and stability that 80 meter signals have. Without a product detector, this modified receiver can pick up and hold s.s.b. signals with comparative ease. ■

[1]Erdman, A. C., "A Direct Reading Capacity Meter," CQ, Nov. 65, page 35.

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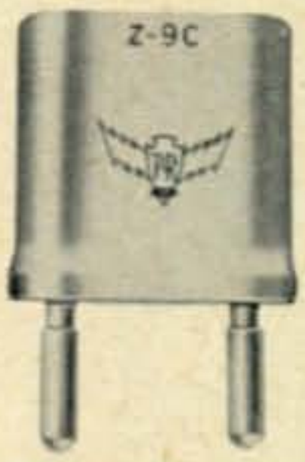

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For further information, check number 14, on page 110

CQ World-Wide DX Contest

C.W.—All-Time Records—C.W.

BELOW is a detailed breakdown on the performances of some of amateur radios C.W. Champions, determined by their showing in our *CQ* World-Wide DX (C.W.) Contests over the years. The contest-minded amateur will find them fascinating reading. Aiming for a new record in a particular category? Here's what you're up against. (Numbers following calls are Year, Points, Contacts, Zones and Countries.)

Single Band, Single Operator
All-Time African Records

1.8	No Entrant				
3.5	No Entrant				
7.0	5A1TW ('64)	227,814	918	22	64
14.0	9J2VB ('65)	317,044	800	33	101
21.0	ZS61W ('65)	440,213	1081	36	103
28.0	OQ5IG ('59)	69,363	356	20	43

Single Band, Single Operator
All-Time European Records

1.8	OK1ZC ('64)	3,060	167	5	15
3.5	DJ3KR ('65)	46,130	416	18	52
7.0	IT1TAI ('64)	115,346	764	27	80
14.0	G2LB ('57)	213,112	701	36	100
21.0	OK1LM ('57)	114,627	585	28	69
28.0	DL4AAP ('57)	253,680	728	36	84

Single Band, Single Operator
All-Time South American Records

1.8	No Entrant				
3.5	No Entrant				
7.0	PY4AP ('64)	81,673	421	22	45
14.0	PY2SO ('65)	473,156	1169	35	104
21.0	CX2CO ('57)	193,719	703	30	63
28.0	PY1HQ ('56)	39,944	225	18	34

Single Operator, All Band

AF	7G1A ('61)	1,177,893	1536	79	182
AS	HL9KH ('62)	1,142,748	1554	103	221
EU	SVØWP ('58)	878,000	1384	77	194
NA	W4KFC ('65)	847,314	839	97	254
SA	CX2CO ('65)	1,252,275	1508	95	188
OC	VR2EW ('65)	2,499,536	2215	126	268

Multi-Operator/Single Transmitter

AF	ET3USA ('65)	1,071,312	1388	73	191
AS	UA9KDP ('62)	1,033,184	1164	86	246
EU	UA3KAS ('65)	990,943	1162	112	337
NA	HKØZU ('62)	791,280	2251	61	107
SA	CX2CO ('62)	1,103,721	1628	83	150
OC	VK5NO ('63)	945,248	1199	86	185

Multi-Operator, Multi-Transmitter

AF	CN8IF ('57)	773,640	1244	58	152
AS	4X9HQ ('62)	1,681,988	1975	84	224
EU	DJ3JZ ('61)	1,451,437	1750	103	256
NA	K2GL ('65)	2,513,448	1729	130	374
SA	YV9AA ('65)	1,865,208	2236	90	192
OC	KG6FAE ('57)	691,601	1321	76	105

Single Band, Single Operator
World Records

1.8	OK1ZC ('64)	3,060	167	5	15
3.5	4X4DH ('64)	55,440	301	14	49
7.0	5A1TW ('64)	227,814	918	22	64
14.0	PY2SO ('65)	473,156	1169	35	104
21.0	ZS6IW ('65)	440,213	1081	36	103
28.0	DL4AAP ('57)	253,680	728	36	84

Single Band, Single Operator
All-Time Asian Records

1.8	JA3AA ('64)	3	6	1	2
3.5	4X4DH ('64)	55,440	301	14	49
7.0	4X4FA ('64)	174,505	781	25	60
14.0	HL9KH ('63)	339,920	910	37	103
21.0	JA3IS ('59)	126,168	519	31	53
28.0	JA3IS ('58)	87,685	423	24	47

Single Band, Single Operator
All-Time North American Records

1.8	VE2UQ ('64)	2,626	102	6	7
3.5	W8NBK ('65)	20,800	126	20	45
7.0	W6AM ('64)	161,991	468	37	86
14.0	W4KFC ('64)	266,631	644	34	107
21.0	W4YHD ('58)	180,340	504	37	90
28.0	K8AEK ('58)	166,270	520	37	93

Single Band, Single Operator
All-Time Oceanian Records

1.8	VK5NO ('64)	6	1	1	1
3.5	ZL2GS ('63)	4,368	67	12	12
7.0	VK3AZZ ('62)	82,289	459	22	39
14.0	VK3ADB ('65)	295,596	788	35	91
21.0	KH6DLF ('59)	156,658	720	31	43
28.0	VK2JX ('56)	16,480	140	16	24

STATION	BAND	QSO'S	ZONES	COUNTRIES
VR2EW (1965) 2,499,536	1.8	—	—	—
	3.5	101	19	36
	7.0	514	27	54
	14.0	834	34	93
	21.0	737	34	73
	28.0	29	12	12
	TOTAL	2215	126	268

STATION	BAND	QSO'S	ZONES	COUNTRIES
CX2CO (1962) 1,103,721	1.8	3	2	3
	3.5	5	4	5
	7.0	234	16	24
	14.0	741	30	62
	21.0	555	20	41
	28.0	90	11	15
	TOTAL	1628	83	150

STATION	BAND	QSO'S	ZONES	COUNTRIES
K2GL (1965) 2,513,448	1.8	21	8	11
	3.5	176	22	54
	7.0	521	29	91
	14.0	674	34	113
	21.0	319	29	98
	28.0	18	8	7
	TOTAL	1729	130	374

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COIL 370-15	$12.75
COIL 370-11	$11.95
COIL 370-10	$11.95

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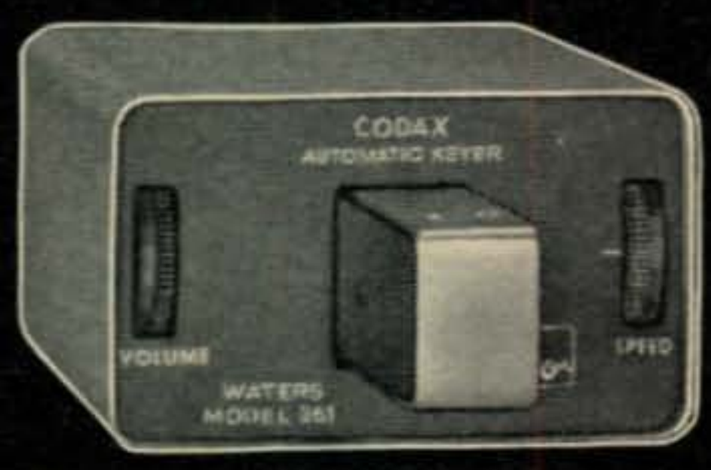

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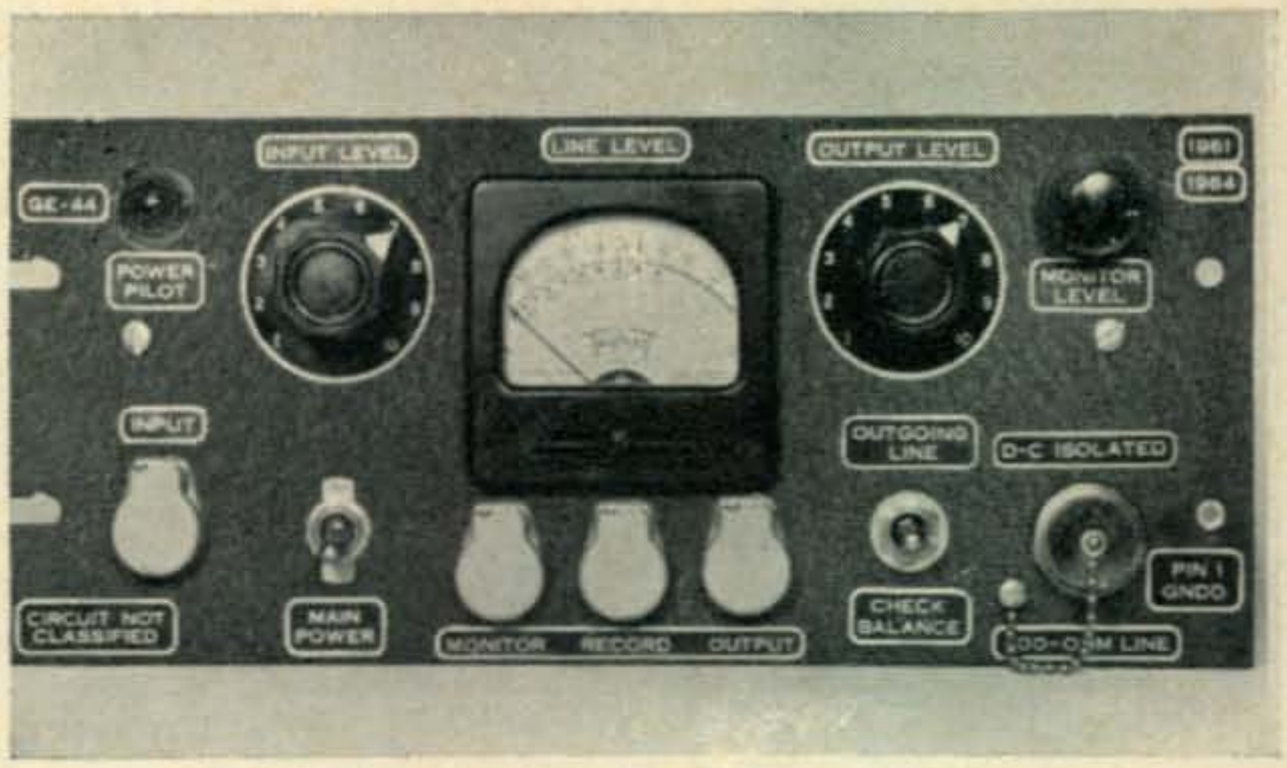
Front view of the hybrid phone patch.



THE DE LUXE HYBRID PHONE PATCH

BY RONALD L. IVES*

PHONE patching has become a common procedure in both amateur and commercial radio operating, and, in recent years, it has been used more and more frequently in telemetering. Results obtained range from surprisingly good to indescribably rotten, the quality of the results depending in large part upon the equipment used and the operating procedure. Best results are obtained when good equipment is used skilfully."

Successful phone patching requires, among other things, that a radio link be connected to a telephone system in such a way that intelligibility is degraded as little as possible, while at the same time meeting the rather stringent limitations of amplitude and frequency range imposed by the characteristics of any standard telephone system.

In summary, the audio signal fed into the phone line must not exceed 0 dbm; must be free of impulse noise; must be d.c. isolated from the telephone system; should not contain frequencies much above 3500 c.p.s.; and (in some areas) must not consist of sustained signals of a single frequency.

Too much audio volume will lead to crosstalk; d.c. connections to the line will disrupt service over a wide area; high frequencies will be lost insofar as the receiver of the message is concerned, but may creep into the carrier channels, interfering with other services. Sustained signals of a single frequency may cause switching and alarm troubles, their exact nature depending upon the local subsidiary services provided by the phone company.

Whatever the local tariffs and regulations may be, if your phone patch operations interfere with service, you will be in trouble, and this trouble is likely to take the form of discontinued service.

Reduction of impulse noise is best done in the receiver proper, using any one of a variety of well known and tested noise limiter circuits. Best results have been obtained with the Bishop limiter[1], which is connected in the receiver i.f. system, and keeps rectified impulse noise out of

*2075 Harvard St., Palo Alto, California 94306.

[1]Bishop, Nathaniel, "Noise Limiter for Mobile VHF," *Electronics*, June 1953, p. 164.

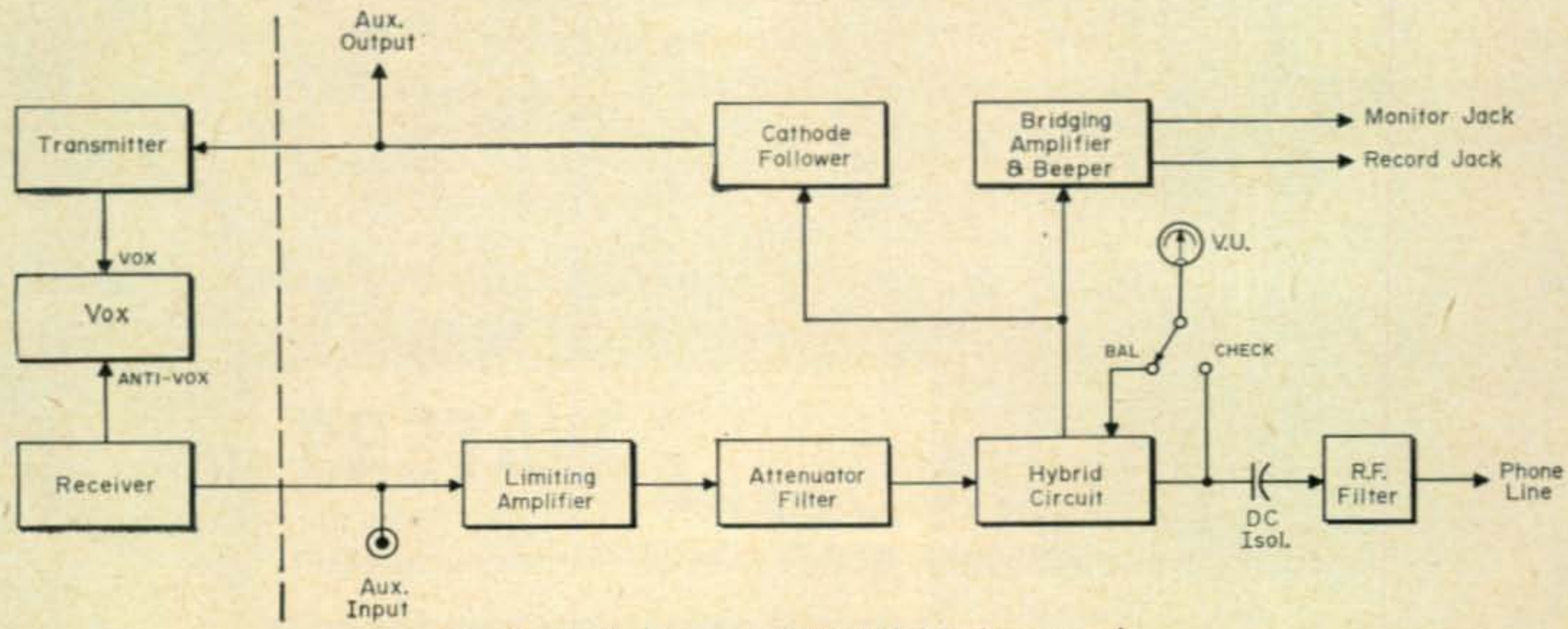


Fig. 1—Block diagram of the hybrid phone patch.

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Proof. Photograph shows **SB-34** and **SB2-LA** together as a complete 1KW, 4-band sideband station (including receiver of course) beating a full house handily. The two units placed end-to-end occupy less than 2 linear feet—just over 1 foot in depth, less than 6 inches high!

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SB-34 specifically, is advanced equipment—predominantly solid-state—in pace with the trend toward elimination of all tubes in a host of electronic gear. The SB-34 SSB transceiver costs only 395.00 (**with** 12V DC and 117V AC built-in power supply) and uses 23 transistors, 18 diodes, a zener, a varactor—and only 3 tubes!

Highlights: SB-34: 4-bands: 3775-4025 kc, 7050-7300 kc, 14.1-14.35 mc, 21.2-21.45 mc. • 135W p.e.p. input (slightly lower on 15) • Built-in dual 117V AC/12V DC supply (negative ground) • Collins mechanical filter • Panel selectable USB-LSB • 11¼"W, 10"D, 5"H. Weight: 19 lbs.

SB2-LA: 80-40-20-15 meters • Input SSB: 1KW p.e.p. AM: 300W. CW-FM-FSK: 400W. • Built-in 117V AC power supply • 12"W, 12½"D, 5¾"H. Weight: 40 lbs.

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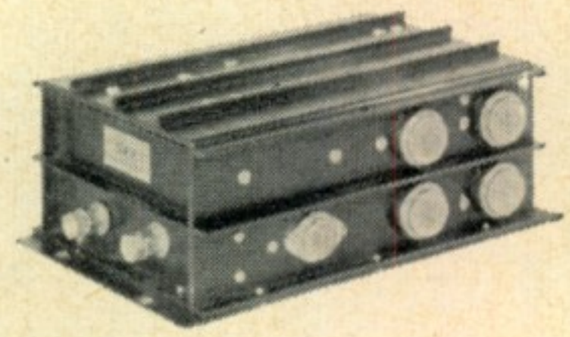

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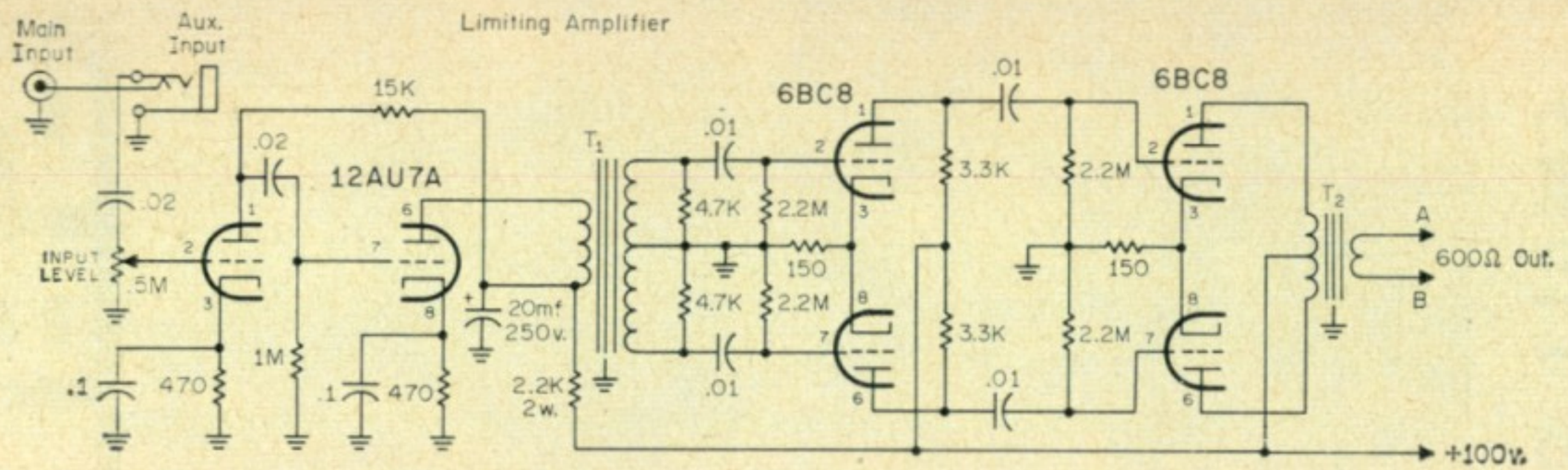
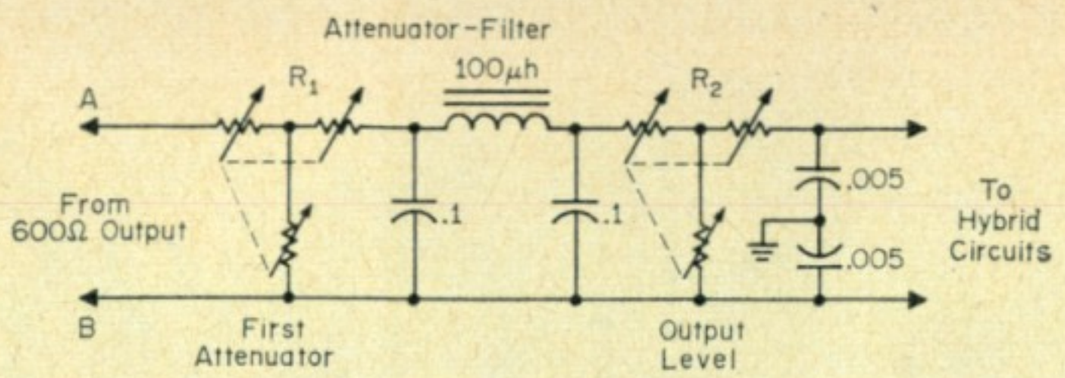
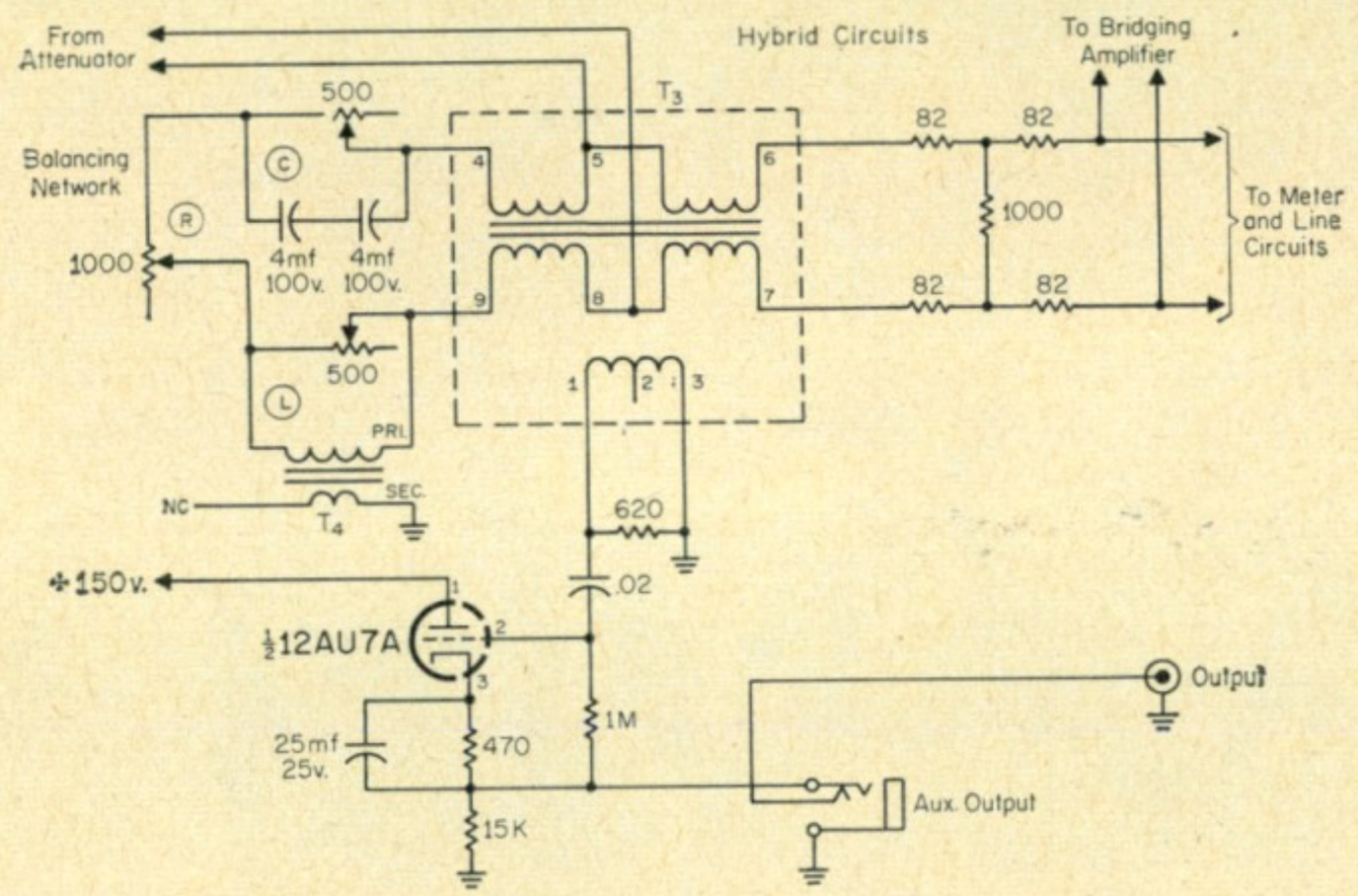
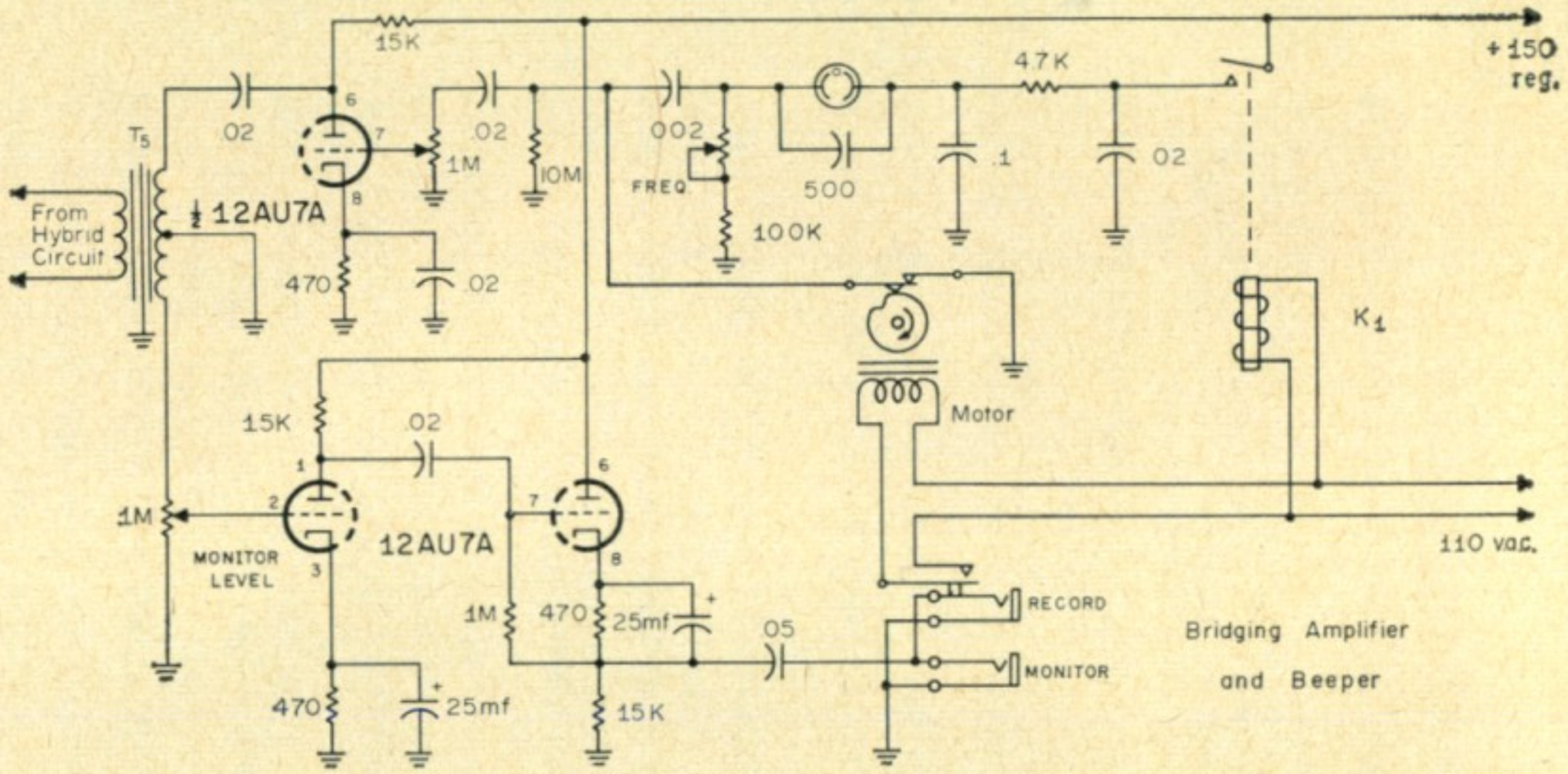
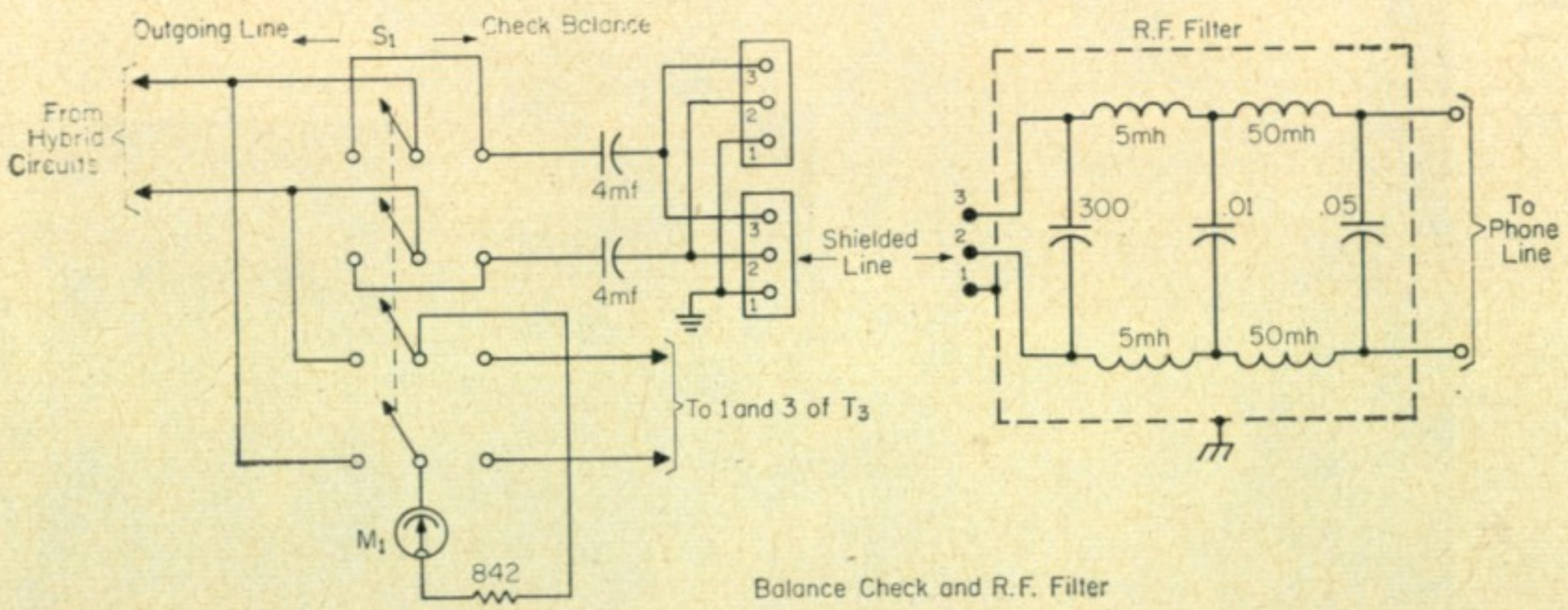










Balance Check and R.F. Filter

Fig. 2—Circuit of the hybrid phone patch. All resistors are ½ watt unless otherwise noted. All capacitor values less than one are in mf. Capacitor values greater than one are in mmf unless otherwise noted.

K_1—117 v.a.c. relay. S.p.s.t. Advance GHA-1C or equiv.
M_1—V.u. meter. Triplett 327-T or equiv.
Motor-Cramer 117 v.a.c., 4 r.p.m. repeating timer.
R_1, R_2—600 ohm T pads. Mallory T-600 or equiv.
S_1—4 p.d.t. toggle switch with center off position.
T_1—5K pri. to p.p. grids. Triad A-83X or equiv.
T_2—18K c.t. to 600/250/50 ohm secondary. Triad A-53X or equiv.
TT_3—Three sets of balanced windings 500/600 ohms. UTC LS-141 or equiv.
T_4—Output transformer 10K to 4 ohms, 5 watts. Stancor A-3879 or equiv.
T_5—Single plate, 7K to 15K, to p.p. grids. Stancor A-53C or equiv.

the a.v.c. circuit. Thermionic diodes and biased solid state diodes work equally well in this circuit.

Block Diagram

A block diagram of the phone patch to be described is shown in fig. 1. In general, each block is electrically discrete, and can be used to perform the same function in other equipment if so desired. The power supply is shared by all blocks.

Limiting Amplifier

To keep the signal amplitude excursions within the allowable range of the telephone line automatically, some sort of limiter is desirable. The well known peak limiter, or clipper, tends to degrade intelligibility and produce splatter, as was pointed out by Smith and Hale[2]. Intelligibility is improved, and splatter is reduced by use of a following filter, but audio quality still leaves much to be desired.

A much better amplitude limiter is the envelope limiter, developed about forty years ago by Bell Telephone Laboratories for use with the transoceanic telephone links. A simplified version of this, using modern components, has been described by Daniel [3]. The circuit of the limiting amplifier used here, is based in large part on Daniel's circuit.

It is a two stage grid limiter, in which the bias on the limiter tubes (6BC8) is produced by grid rectification, and is substantially proportional to the average amplitude of the incoming signal. With the constants shown, the output is very nearly constant, regardless of input, after limiting begins. Input is adjustable, so that the degree of limiting can be varied to suit operating conditions. This is quite important when maximum intelligibility is desired, as too much limiting, whether at transmitter or receiver, lowers intelligibility and "mushes" the signal.

Rear view of the hybrid phone patch. The timer motor is on the left followed by the silicon rectifiers, the filter choke and the power transformer.

Output of the limiting amplifier is considerably greater than is desirable for phone patch service and may contain frequencies too high for optimum phone transmission. To reduce output, and eliminate higher frequencies, the output transformer feeds a 600 ohm T pad, which is followed by a pi a.f. filter, and this, in turn, is followed by another 600 ohm T pad which is controllable from the front panel (OUTPUT LEVEL).

To prevent "core talk" and to reduce coupling, both input and output transformers of the limiting amplifier are potted in small aluminum shield cans. Be sure that the transformer cores are well grounded.

The Hybrid Circuits

The purpose of the hybrid circuits is to separate the outgoing signal from the receiver to the phone line from the incoming signal from the phone line to the transmitter. These circuits, employing a special three-winding transformer, function somewhat like a balanced bridge, nulling out the receiver signal so far as the transmitter is concerned, and preventing systemic "singing."

Critical elements in the hybrid circuits are the transformer, here a UTC LS-141, and the bal-

[2]Smith, J. W., and Hale, N.H., "Let's Not Overmodulate —It Isn't Necessary," *QST*, Nov. 1964, p. 22.

[3]Daniel, D. B., "The Consonant Amplifier—Limiter," *Radio and Television News*, Vol. 57, No. 3, March, 1957, p. 49.

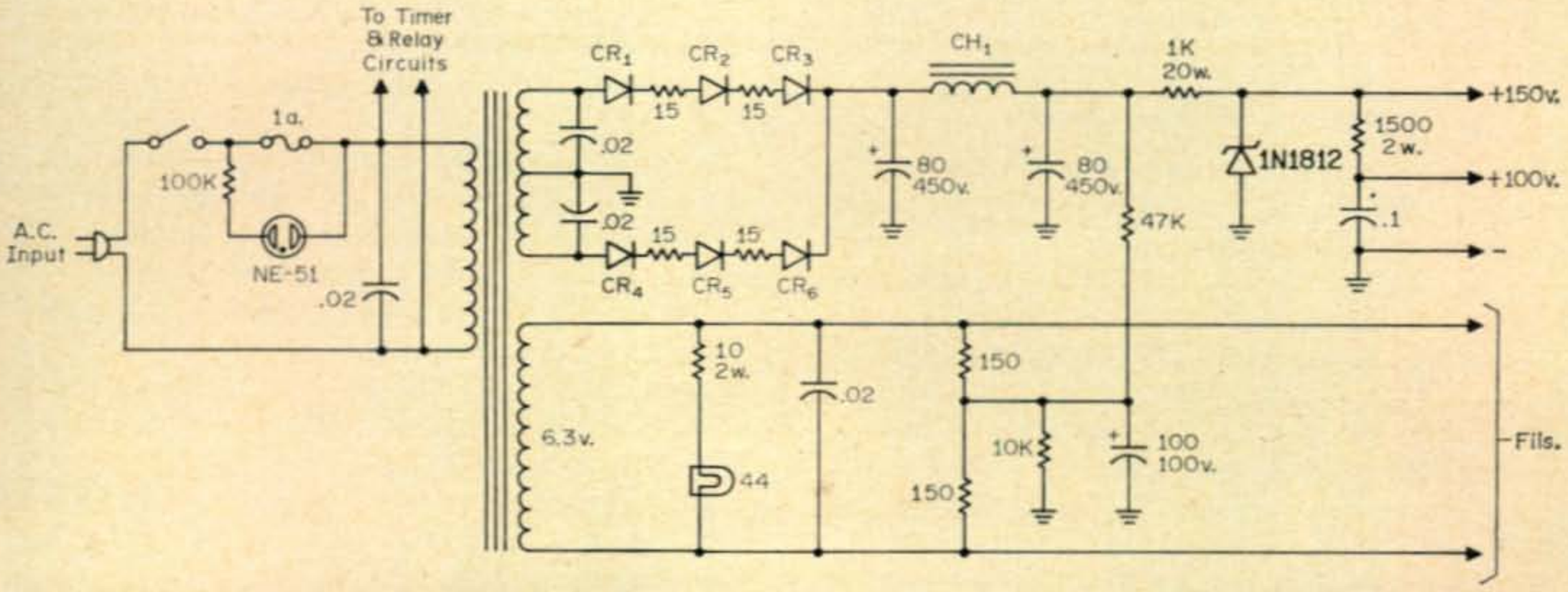
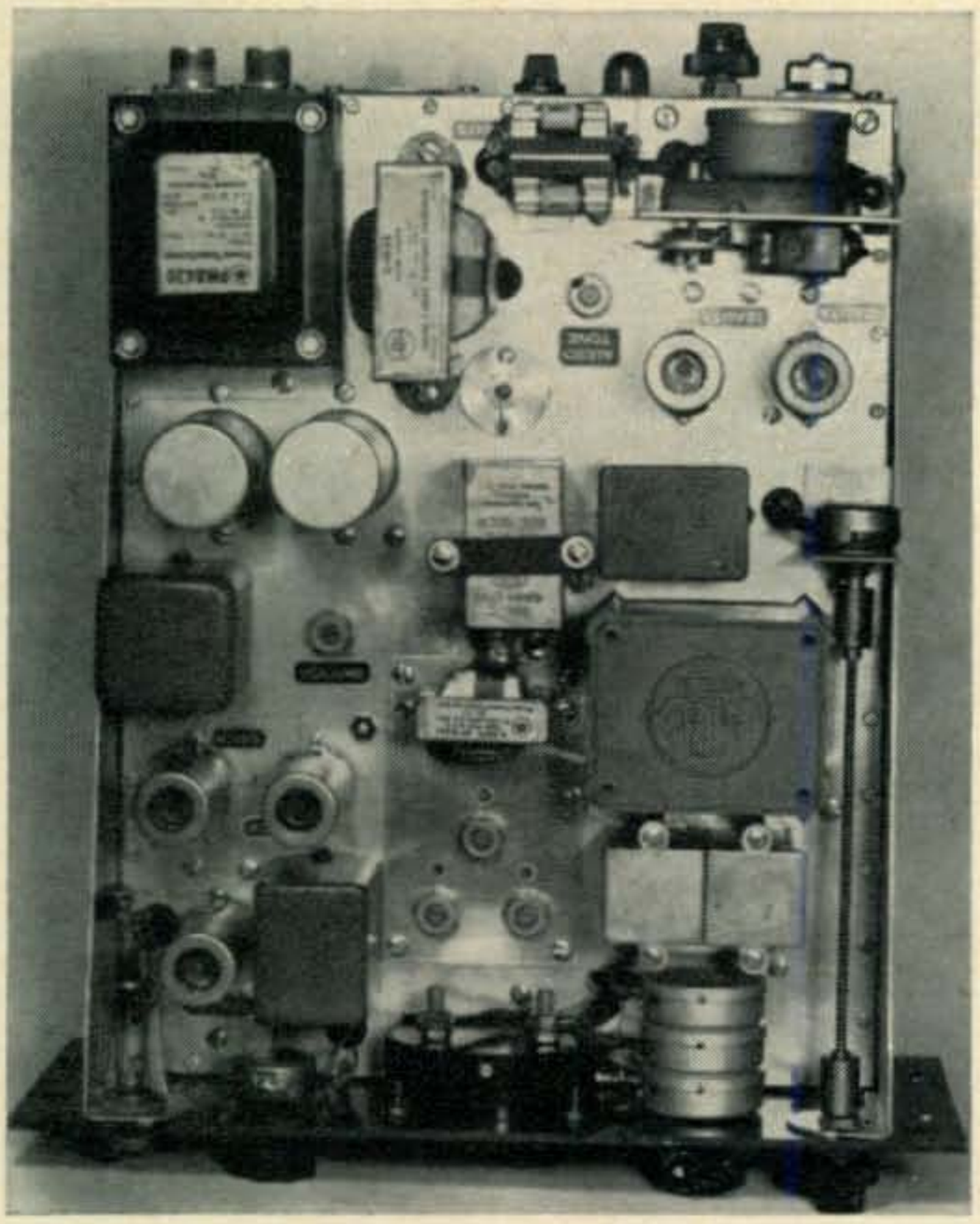
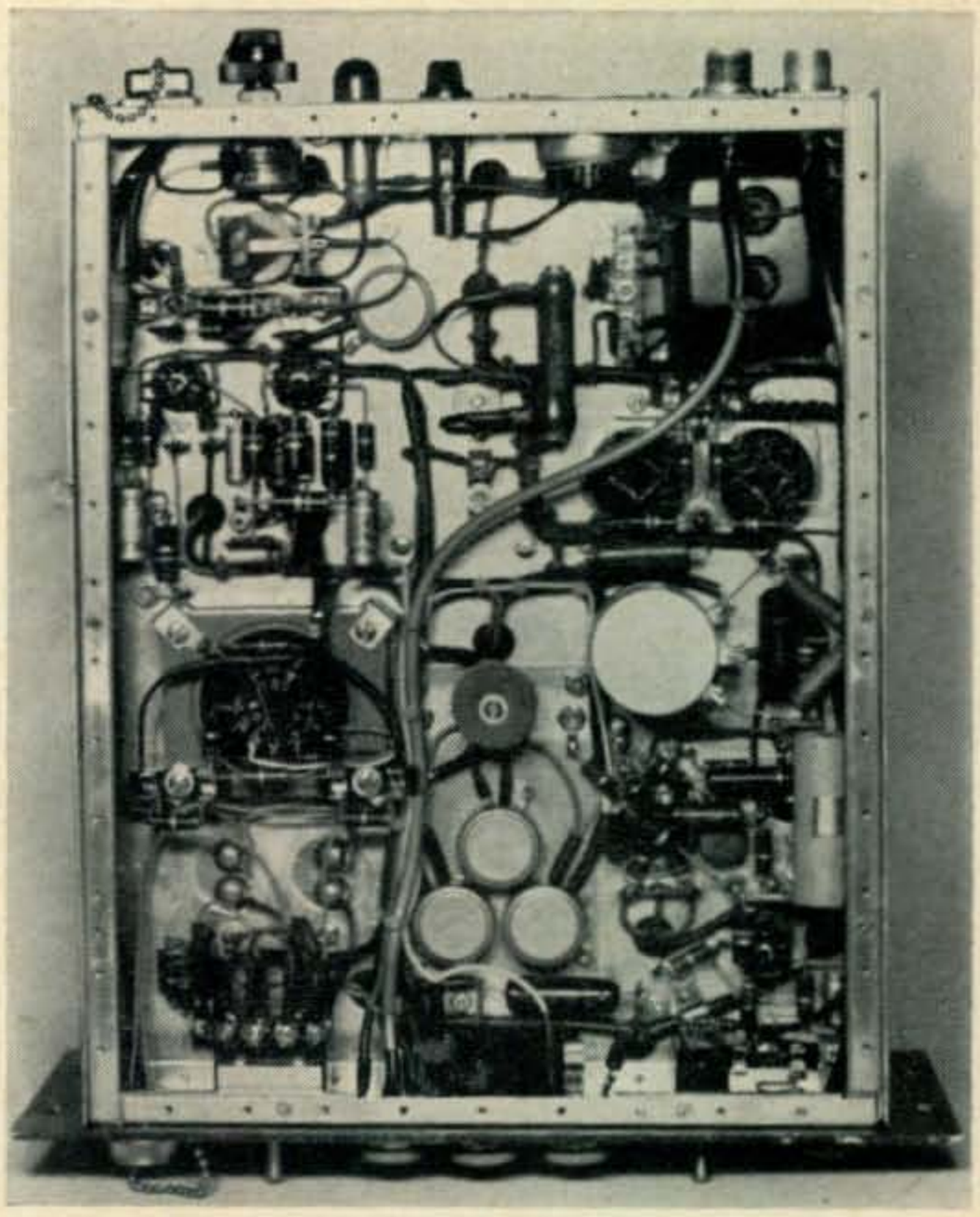


Fig. 3—Power supply circuit for the hybrid phone patch provides well filtered regulated output. Diode CR_7 is mounted on the chassis for heat sinking. All capacitors are in mf. All resistors are ½ watt unless otherwise noted.

CH_1—15 h, 75 ma. Stancor C-1002 or equiv.
CR_1 to CR_6—Silicon diodes, 350 p.i.v., 500 ma. Sarkes Tarzian M-500 or equiv.
T_1—520 v.c.t. at 90 ma., 6.3 v. at 4a. Stancor PM-8420 or equiv.





Top and bottom views of the hybrid phone patch showing the location of the major components. In the top view the limiter amplifier is in the lower left corner. The balancing adjustments are in the center, behind the meter. The hybrid transformer, to the right, is mounted through a hole in the chassis and held with brackets in order to clear the height limit. The power supply is in the upper left and the bridging amplifier and beeper are in the upper right corner. The relay, K_1, can be seen in the upper left corner of the bottom view.

ancing network, which simulates a phone line, permitting the system to be balanced. Attainable rejection of the unwanted signal depends largely upon the quality of the hybrid transformer and the adjustment of the balancing network.

The hybrid circuits are reasonably conventional except that the output to the transmitter is fed through a cathode follower. This blocks any r.f. feedthrough, and makes the adjustment of the hybrid balancer independent of the load.

Isolating the hybrid transformer from the phone line is a small resistive pad, whose purpose is to make the system balance insensitive to minor changes in the phone line characteristics. With this arrangement, balance will be almost the same whether you are talking over a local or a long distance circuit.

Meter And Line Circuits

The meter and line circuits connect the hybrid circuits to the phone line, provide the necessary d.c. isolation and permit monitoring of signal levels and balance at all times. The r.f. filter will be described here also.

Meter and line circuits are also shown in fig. 2. Experience has shown that the r.f. filter should be as close to the phone line connection as possible, and that the line from the phone patch to the phone line connecting point should be shielded.

Switch S_1 permits checking of audio signal in the phone line in the up position, checking of balance in the down position and disconnection of the patch from the phone line in the center position. This permits transacting telephone business with the patch ready for use, but keeps this business, including dial and signaling tones, off the air.

Dual line plugs, one on the chassis skirt in the rear, and one on the front panel, are provided for convenience.

Bridging Amplifier And Beeper

The bridging amplifier permits monitoring of both sides of the patched contact, facilitating fill-ins and translations. The beeper inserts the required warning tone when the messages are being recorded.

Because it is designed for headset operation, the monitoring circuit has a low impedance output (cathode follower). For comfort in listening, the monitor level is adjustable from the front panel.

To improve shielding and reduce "core talk," the input transformer of the bridging amplifier is potted in a small aluminum can, and a ground lead for the core brought out. Construction and operation of the bridging amplifier is entirely standard and conventional.

The beeper is a tone generator, producing a warning tone in accord with the FCC Docket No. 6787. This is a 1400 cycle tone, lasting 1/5 of a second, repeated every 15 seconds, and having a level equal to the average telephone talking signal strength. The tone generator is a neon oscillator, controlled by a synchronous repeating timer and driving one section of a 12AU7A.

[*Continued on page 99*]

View of the LR-1 direct reading frequency meter, in use. Note that the two coaxial connectors to the left and right of the meter have been changed to BNC fittings.

THE LR-1 FREQUENCY METER

BY SAM KELLY,* W6JTT

The author describes how to get the LR-1 working and how to operate it. This fine direct reading frequency meter is becoming available on the surplus market in greater quantity.

One of the few interesting surplus items to reach the ham market in the past year is the LR-1 frequency meter. It is very attractive to the ham since in addition to its heterodyne frequency meter function it will generate and measure audio frequencies up to 5.5 kc and provide crystal calibrator outputs of 10, 20 and 100 kc.

The LR-1 accuracy is specified as ± 0.003% from 160 kc to 30 mc. A multiplier chart is supplied for use of harmonics up to 60 mc.

To place the LR-1 in operation remove the cover from the terminal and filter assembly and connect 115 v. 60 cycles to the terminals marked "60." These terminals should have a green and a green/yellow wire connected to them. Install fuse F_{101} in the fuse clips whose voltage markings most closely approximate the line voltage in your shack. The r.f. input and output connectors are impossible to match and should be replaced with BNC type UG-604/U.

*12811 Owen Street, Garden Grove, California 92641.

Operation of the LR-1 is more involved than using a LM or BC-221. It is a direct reading instrument requiring no calibration book, but the operation is unique.

Crystal Calibrator

The calibrator consists of a 100 kc crystal oscillator accurate to one part in 10^5. A capacitor is provided for adjusting the oscillator against a primary standard such as WWV or WWVH. This adjustment (C_{102}) shouldn't be touched unless it is necessary. If you do adjust the oscillator use an oscilloscope to compare the beat notes—don't rely upon your ears.

Locked to the crystal oscillator is an astable multivibrator which provides 10 and 20 kc calibration markers. To determine if the multivibrator is properly dividing the 100 kc signal proceed as follows:

Remove amplifier tube V_{102}. Place the CALIBRATOR switch in the 100 kc position. Using the heterodyne frequency meter direct reading dial check for the 200 kc harmonic. It should be with-

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in ± 1 kc of the 200 kc dial marker. If not, adjust R_{114} until it is. Replace V_{102} and allow the tube to warm up. Place the RANGE SELECTOR switch in the 1.33—1.87 mc range. Vary the HFM tuning control noting the dial reading on two successive 100 kc harmonics. Place the CALIBRATOR switch in the 20 kc position and count the number of zero beat points between the two 100 kc readings. It should be five. If not, adjust R_{113} until it is. Repeat the above procedure for the 10 kc position adjusting R_{112} until there are ten zero beat points between the two 100 kc readings.

To use the crystal calibrator for external measurements turn the CALIBRATOR switch to the desired range and place the DETECTOR INPUT switch in the MEASURE position. It may be necessary to move the HFM tuning control to eliminate spurious beat notes.

Heterodyne Frequency Meter

The heterodyine frequency meter (H.F.M.) consists of a Colpitts oscillator operating on seven fundamental ranges. Scales with black masks are fundamental ranges while the red masks are harmonic ranges. The COMPENSATOR control is provided for zero beating the H.F.M. with the crystal check points. The interpolator scale test control provides a smoothly controllable change in frequency without the need of disturbing the main tuning control. This is useful in determining the sense of the beat note. Turning this control will reduce the H.F.M. frequency.

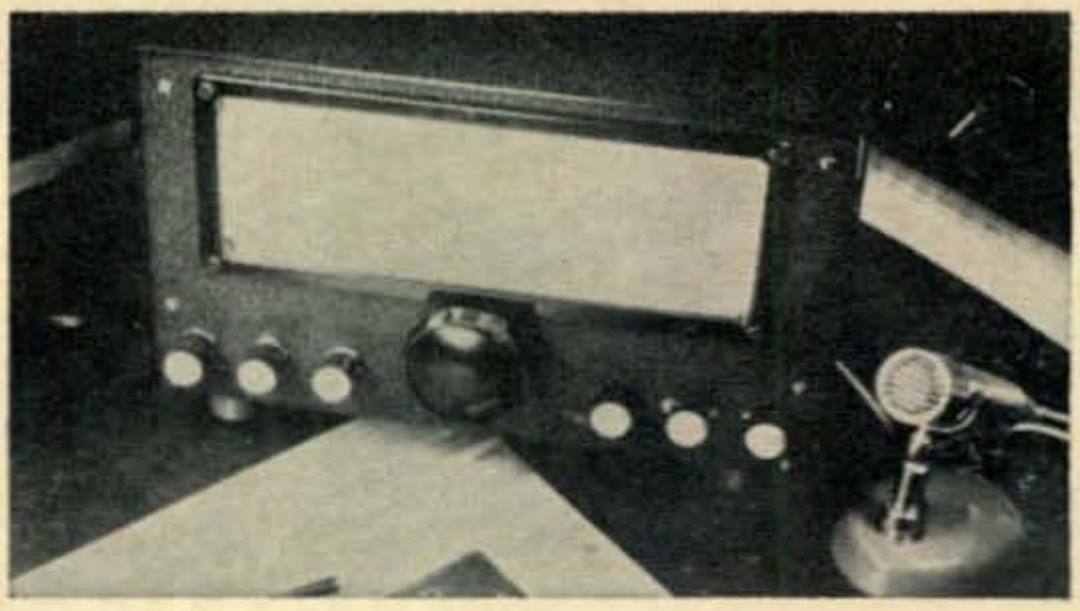
Placing the detector input switch in the MEASURE position allows you to adjust the H.F.M. against the crystal calibrator. Also, in this position, the difference in frequency between an unknown signal applied to the r.f. input connector and the crystal calibrator is directly read out on the interpolator dial. The sense (whether the signal is above or below the check point) is determined by means of the INTERPOLATOR SCALE TEST control. As an example, say you zero beat the H.F.M. against the crystal calibrator at 5.120 mc (calibrator in the 20 kc position). An unknown signal is fed in and meter M_{101} reads 6 kc on the lower scale. Turning the INTERPOLATOR SCALE TEST control you observe that the reading on M_{101} drops. This indicates that the H.F.M. is above the unknown signal and therefore the signal is 5.114 mc.

Placing the detector input switch in the MATCH position permits you to zero beat the H.F.M. with an external unknown frequency.

Measuring Audio Frequencies

The LR-1 can be used as an audio frequency meter by connecting the unknown signal to J_{103} (INTERPOLATOR INPUT). Use a standard phone plug and connect the hot side to the tip. The input is a high impedance (about 500K ohms). Place the interpolator scale selector switch in the lower position and read the audio frequency directly from the lower scale.

[*Continued on page 102*]



Front view of the 80 meter receiver/tuner. The controls are, from l. to r., ANTENNA TRIMMER #1, ANTENNA TRIMMER #2, CALIBRATOR ON/OFF (if used), MAIN TUNING, USB/LSB, I.F. GAIN and AUDIO GAIN.

An 80 Meter Receiver/Tuner

BY ED MARRINER,* W6BLZ

HERE is an 80 meter receiver which tunes from 3.5 to 4.0 mc. It has a well shielded input circuit that can be used with crystal controlled converters to cover the other amateur bands. No filtering was used in the antenna circuit to reject images because the receiver only tunes the 80 meter band and the selectivity in this range provides good enough rejection.

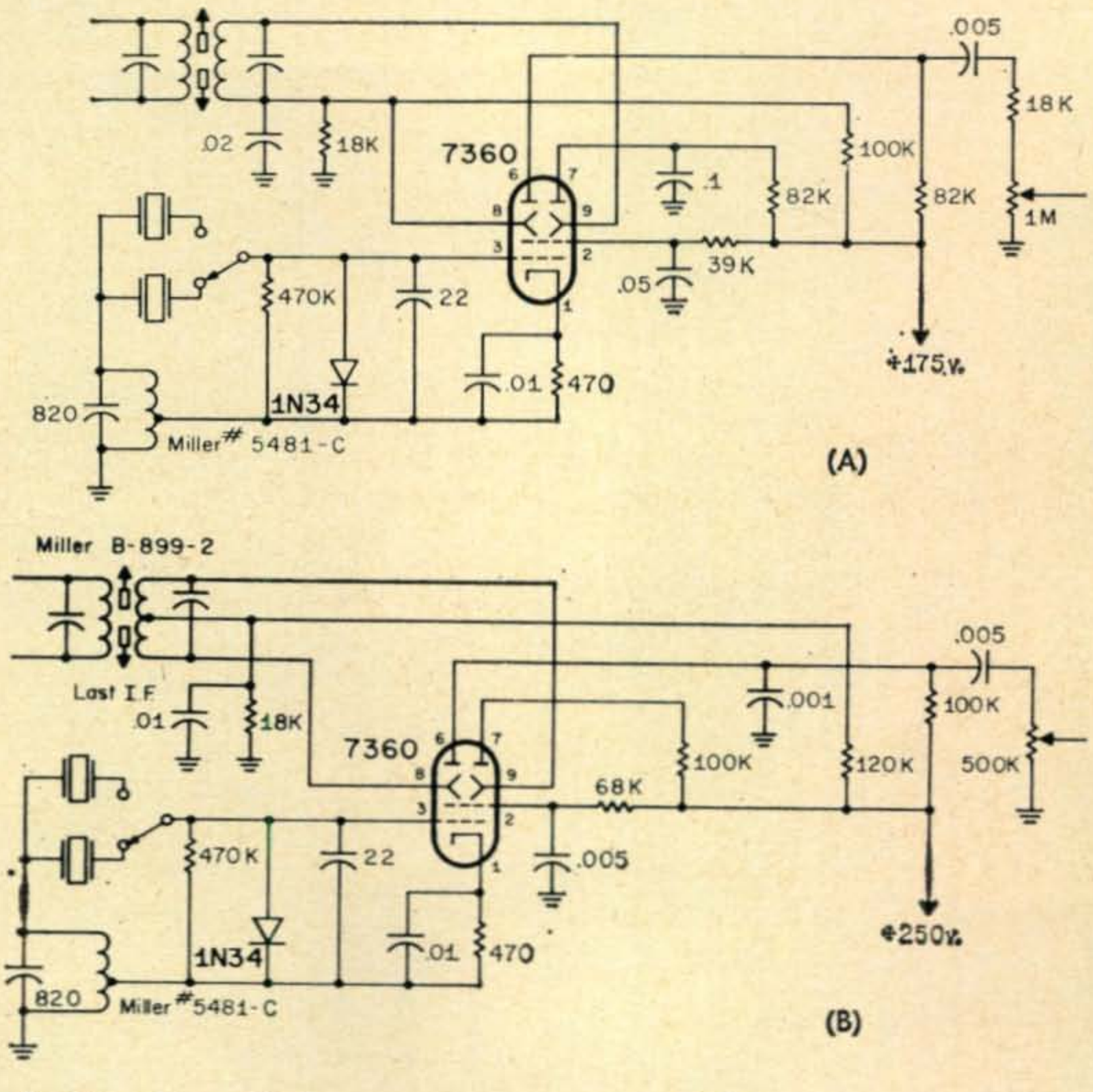
The antenna is fed into the 3.5-4.0 mc grid coil of the 7360 mixer tube. It is well shielded to prevent pick-up when feeding converters into it. The input coil is a 4.7 mc i.f. transformer with both the primary and secondary tuned with variable capacitors. The output signal of the mixer is fed directly into the mechanical filter and then amplified by two stages of i.f. The signal is then fed to a product detector and then to the audio amplifier.

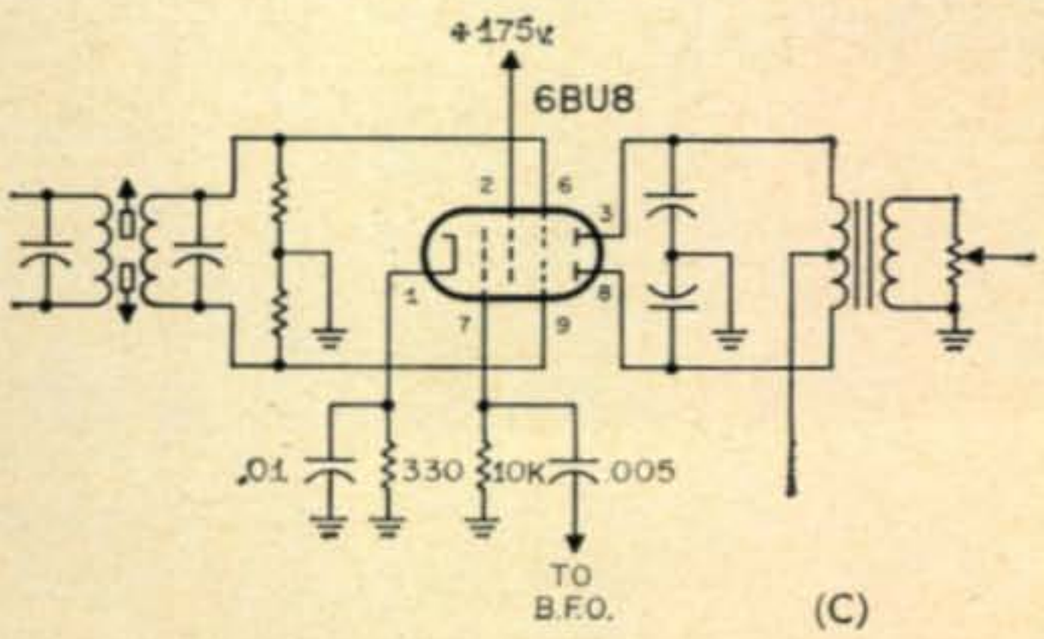
Product Detectors

When the urge to build this receiver hit me I decided to "do it right." It would include "state of the art" circuits gathered from the latest magazines. Since past experience had taught me that circuits described in magazine articles don't often perform as described ("This receiver's different. It *does* work.), it was decided to build it stage by stage, checking along the way.

After the power supply was completed the audio section was built using a 6EB8 (triode and pentode in one envelope). It was a bust due to oscillation at volumes above normal. Out it came and back to the old reliable 6AQ5.

On to more new circuits! A 7360 product detector was tried next. The book from which the circuit was taken neglected to mention the tube's sensitivity to magnetic fields. With the power





*528 Colima Street, La Jolla, California.

Fig. 1 (A) Circuit of a product detector that works well if no power supply is located. (B) Circuit of a similar type but using a balanced input that requires a tapped i.f. transformer secondary. (C) This circuit requires a push-pull type interstage audio transformer for the output. All three circuits are sensitive to hum pick-up but work very well, otherwise.

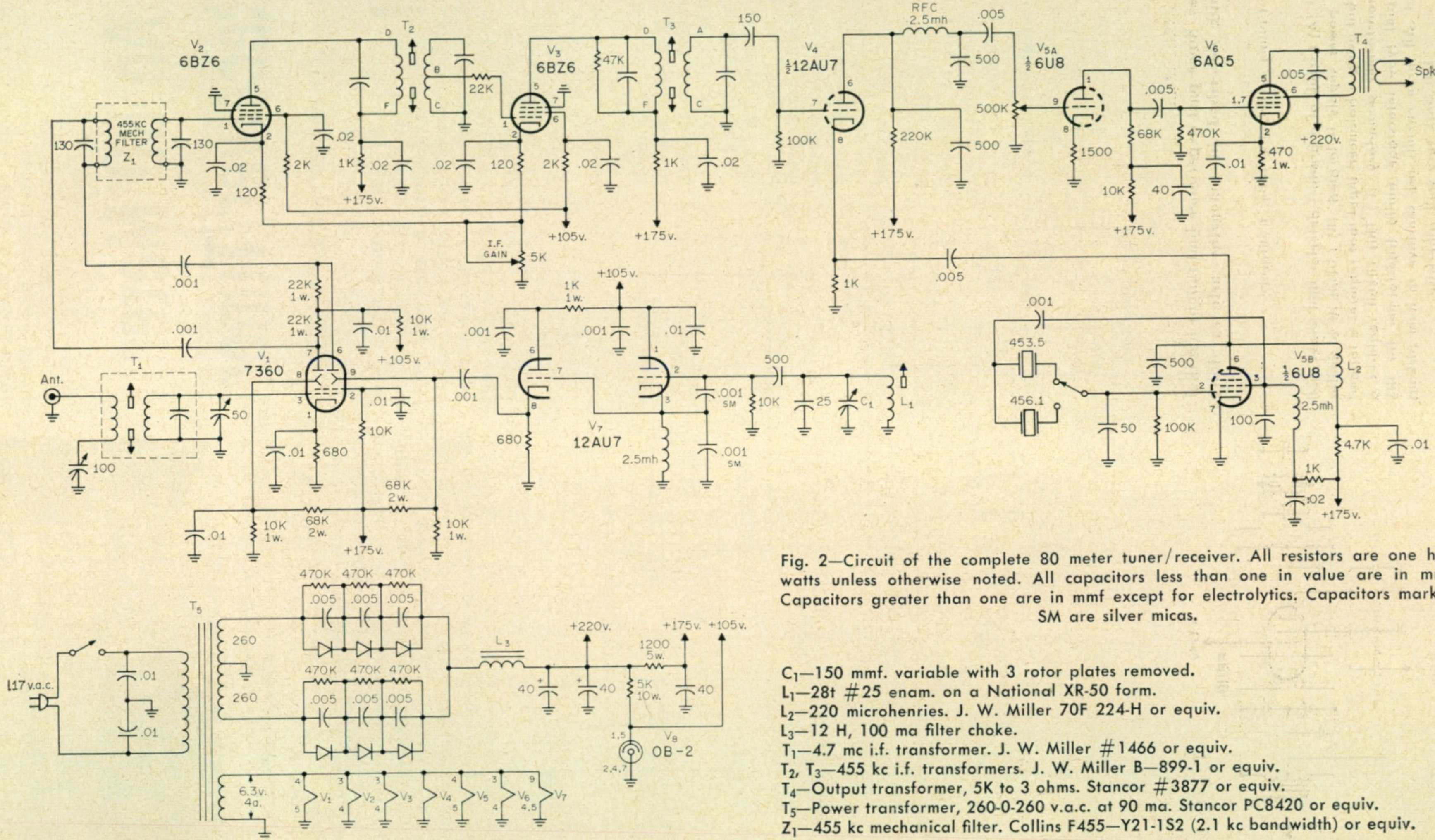


Fig. 2—Circuit of the complete 80 meter tuner/receiver. All resistors are one half watts unless otherwise noted. All capacitors less than one in value are in mmf. Capacitors greater than one are in mmf except for electrolytics. Capacitors marked SM are silver micas.

C_1—150 mmf. variable with 3 rotor plates removed.
L_1—28t #25 enam. on a National XR-50 form.
L_2—220 microhenries. J. W. Miller 70F 224-H or equiv.
L_3—12 H, 100 ma filter choke.
T_1—4.7 mc i.f. transformer. J. W. Miller #1466 or equiv.
T_2, T_3—455 kc i.f. transformers. J. W. Miller B—899-1 or equiv.
T_4—Output transformer, 5K to 3 ohms. Stancor #3877 or equiv.
T_5—Power transformer, 260-0-260 v.a.c. at 90 ma. Stancor PC8420 or equiv.
Z_1—455 kc mechanical filter. Collins F455—Y21-1S2 (2.1 kc bandwidth) or equiv.

transformer mounted on the chassis the hum was impossible. This circuit was the second bust. The 7360 was replaced with a 6BU8. The circuit used requires an interstage transformer which can also pick up hum if not kept away from the power transformer and shielded.

The 6BU8 was used for a time but eventually gave way to the old reliable triode product detector. The parade of circuits used are shown in fig. 1. Circuits (A) and (B) are great if no power transformer is on the chassis.

Construction

The receiver was built on a California Co. chassis, type A-113, 11 × 7 × 2 inches. The panel is a piece of ⅛ inch aluminum 11 × 6½ inches. The panel holes are cut from a template furnished with the British Radio type dial, #898.

The first thing to wire is the power supply so there is power to test out the circuits as they are wired. Next, it is suggested that the 6AQ5 audio stage and one half of the 6U8 audio driver be wired. When the audio amplifier is completed, it can be tested out by feeding in an audio tone. When the audio stages are working, assemble the product detector.

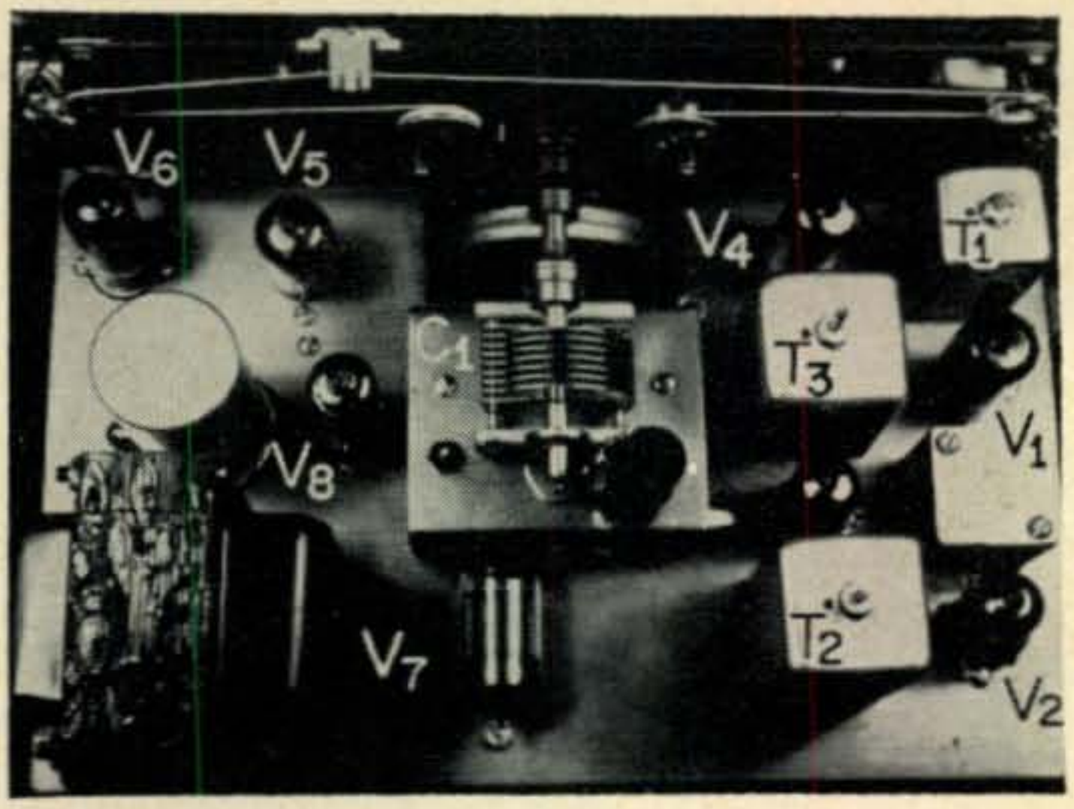
Product Detector—When testing the product detector the input signal *and* the b.f.o. signal is required for operation. Therefore the crystal oscillator b.f.o. (pentode section of the 6U8) must also be built now. A signal of 2 to 4 r.f. volts must be developed across the cathode resistor.

The I.F. Stages—The mechanical filter feeds directly into the first i.f. tube and is tuned by a 130 mmf capacitors.

The second i.f. tube grid is fed from a tap one third down on the secondary winding of the i.f. transformer, through a 22K resistor, to prevent oscillation. The screens of both tubes are supplied from the 100 volt regulated supply. A 47K resistor can be put across the primary of the second i.f. stage if any oscillation occurs when the i.f. gain control is in the full on position.

7360 Mixer Stage—A 4.7 mc i.f. transformer was used as the input coil to the mixer. On the antenna side, the fixed capacitor was removed and it was series tuned with the antenna with a 100 mmf variable capacitor. The primary slug can be adjusted so this capacitor covers the 80 meter band. The secondary is tuned by a 50 mmf variable and the two tuned circuits give enough selectivity to prevent marine band stations from mixing with the oscillator and appearing as unwanted signals.

It was found that voltages on the mixer tube were critical. The deflection plates need very close to 20 to 25 volts on each plate and the 10K and 68K voltage divider provides this voltage. The voltage injection from the v.f.o. to the deflection plate needs to be one to three volts of r.f. On the plate circuit most diagrams shown a 68K plate load resistor; it was found here that a 20K provided more output when fed directly into the mechanical filter. The cathode resistor



Top view of the 80 meter receiver shows the neat and simple layout. The audio transformer, located between T_3 and T_4 was used with the product detector shown in fig. 1 (C) but not with the detector shown in fig. 2.

was set at 680 ohms after experimenting with a variable resistor. It did not mix well with 390 ohms as most circuits call for. After adjustment the 7360 works well as a mixer with low cross modulation and has good overload characteristics.

The B.FO.—The circuit shown in fig. 2 works with surplus crystals as well as International Crystal's type 700. The component values shown are for the surplus type crystals. For International crystals the grid return should be 1 meg shunted by a 22 mmf capacitor and the choke in the screen should be replaced by a 220K resistor; the screen bypass should also be changed from 100 mmf to 50 mmf.

Some oscillator circuits had more harmonic output than others. It was found by tuning the plate load with a 220 microhenry r.f. choke, and the plate bypassed with 500 mmf, the harmonic output was reduced. At 3630 kc the only harmonic falling in the 80 meter band from the b.f.o. was just perceptable.

To completely eliminate the harmonic at 3630 kc it would have to be well shielded and a low pass filter used on the output going to the product detector. It is questionable if it's worth the effort

V.F.O.—The v.f.o. was built by mounting the parts underneath the tuning capacitor mounting bracket. (See fig. 3) The oscillator coil was an XR-50 National coil form filled with #25 enameled wire, about 27 to 28 turns. It will tune from 3055 kc to 3545 kc by adjusting the slug and checking with a g.d.o.

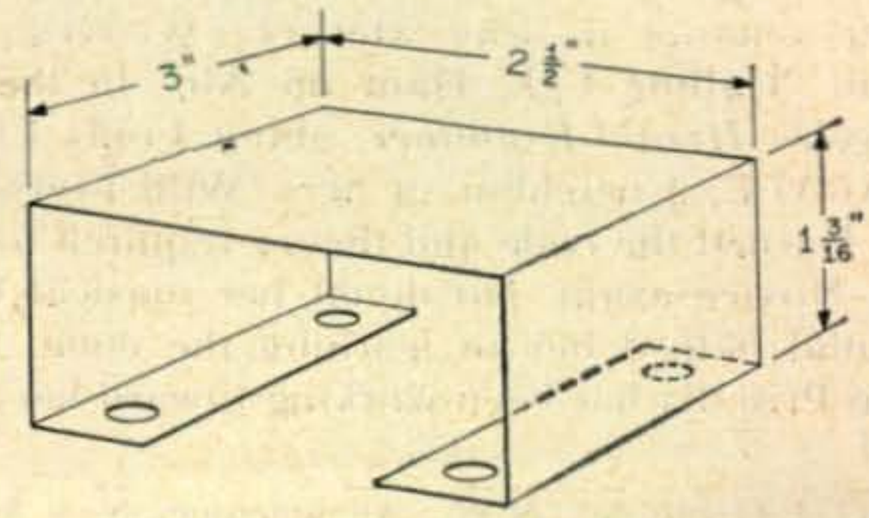


Fig. 3—Dimension to form bracket for mounting of the v.f.o. components, the tuning capacitor, coil and oscillator tube.

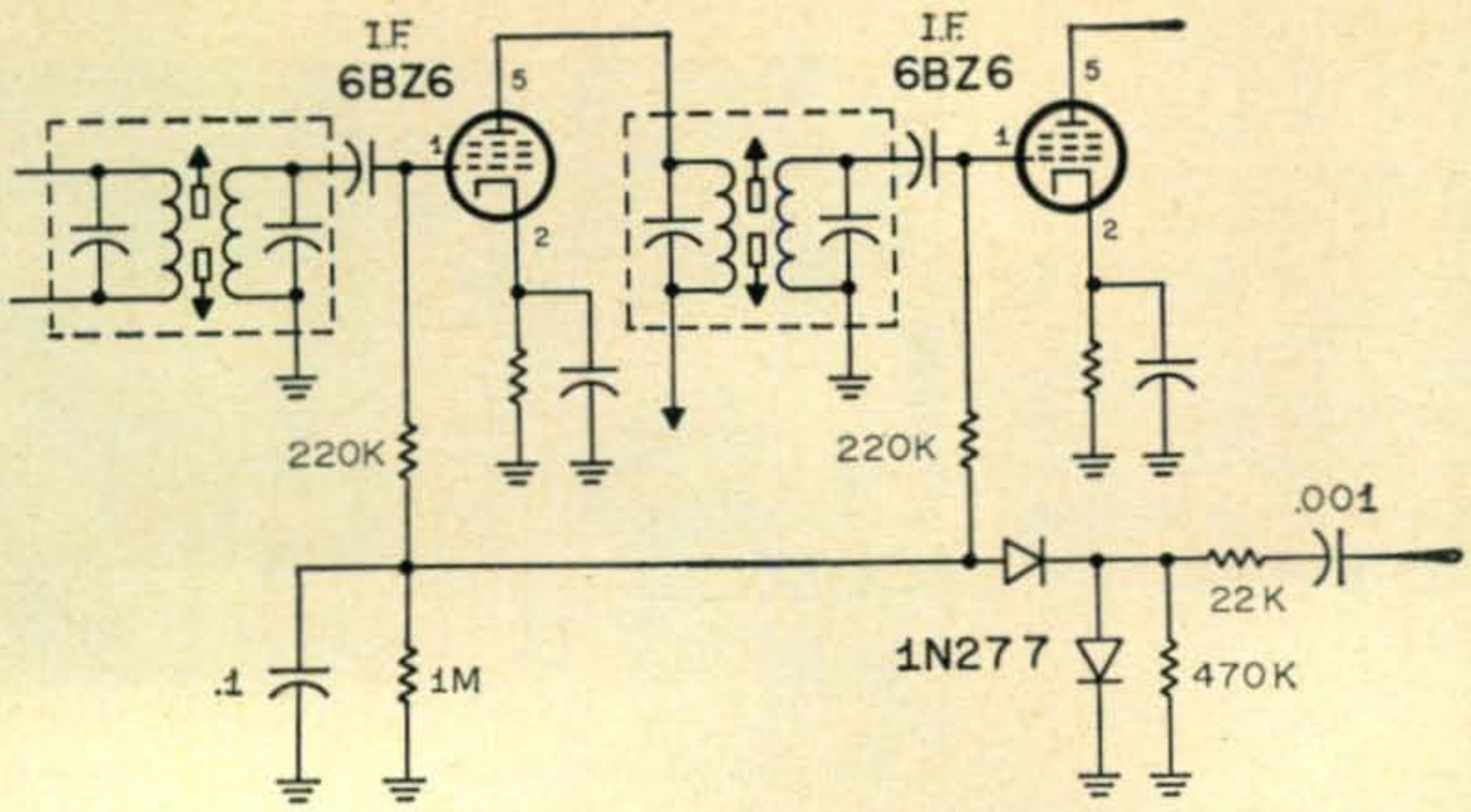


Fig. 4—Simple a.v.c. circuit that may be added as described in the text. The 0.1 mf capacitor and the one meg resistor value can be adjusted to provide the desired time constant.

About 2.0 volts of r.f. is obtained from the cathode follower and fed into the mixer deflection plates. Anything between 1.0 to 3.0 volts seems to work satisfactory. This voltage measurement can be made using a home-made r.f. probe and a v.t.v.m. If too much voltage is available the capacitor feeding the deflection plate can be reduced.

A.V.C.

No a.v.c. was used on the receiver because it was desired to have an i.f. gain control and also have the audio gain in front of the triode audio stage. If a.v.c. *is* used, the audio gain will have to be inserted in the 6AQ5 grid and the triode run full on, and also the i.f. stages. Generally, enough signal can be taken off from the plate of the audio stage, rectified and applied to the grids of the 6BZ6's through 220K resistors as shown in fig. 4. More elaborate circuits are shown in the handbooks. If you are interested in s.s.b. operation a.v.c. is a must.

Conclusion

A homebrew receiver is actually never completed; there is no end to trying new circuits. Since, as pointed out earlier, some circuits perform very well but are very sensitive to hum, it might be best to build the power supply on a separate chassis. This does tend to reduce the hum level and is especially important if earphones are used.

For quietest reception it may be advisable to use a vacuum tube rectifier rather than the silicon diodes shown. Frequently the switching transients get into the audio circuit. Again, if the power supply is built on a separate chassis this is not as difficult. Also be sure not to omit the two live bypass capacitors.

Many other ideas and thoughts pop up but a halt has to be made somewhere so here is the circuit. It is hoped that the discussion and the circuits presented have stimulated your thoughts and ideas on circuit design. ■

Priscilla Paris, WN6RNR

BY LOUISA B. SANDO,* W5RZJ

MEET Priscilla Paris, youngest member of the famous song and dance team known as the Paris Sisters, who for some months now has held amateur license WN6RNR. Priscilla became interested in amateur radio after reading in Ray Meyers', W6MLZ, column, "Calling CQ—Ham on Air" in the Los Angeles *Herald-Examiner*, about Louis Litwin, WA6AFF, a neighbor of hers. With Lou's help she learned the code and theory required to pass her Novice exam. No doubt her musical background helped her in learning the code. Since then Priscilla has been working toward her General.

*4417 Eleventh St., N.W., Albuquerque, New Mexico 87107.

[*Continued on page 100*]

Priscilla Paris, youngest of the famous singing Paris Sisters, holds amateur license WN6RNR.

Component Considerations For V.H.F. Construction

BY IRWIN MATH,* WA2NDM

With the increased interest and construction in the v.h.f. many of the newcomers are experiencing difficulties not encountered in the d.c. and low frequencies. The author explains some of these effects, their causes and cures.

As the electronic technician, radio amateur, and electronic experimenter progress from d.c., audio, and the low radio frequencies into the higher frequency ranges of the electromagnetic spectrum, many new techniques and ideas have to be developed. In most cases, practices that were previously employed at 1 mc simply can not be used at 100 mc. The technician suddenly finds that the 2 mh r.f. choke is not only not "choking off" the signal, but in effect is coupling the r.f. rather nicely into just the place it should be isolating. He also may find that the 0.1 mf bypass capacitor isn't bypassing a single thing; however the 470 mmf capacitor is a wonderful substitute even though it has (by calculation) a much higher reactance. By learning a few basic facts, the newcomer to the v.h.f. frequencies can gain a somewhat better insight to the problems he will encounter.

Lead Inductance

If a length of copper wire were placed in free space where nothing could act upon it, it would be found to have a definite value of inductance, capacitance, and resistance, due to its very nature as a conductor. When placed in a circuit, these distributed values, or properties, would, depending on the frequencies involved, show certain effects. Where the frequency is on the order of 2 or 3 mc, these effects are usually negligible unless the wire is very long. In the v.h.f. region however, these distributed properties may not be ignored. A 4 inch length of #20 wire for example, shows a resistive impedance of only 2 ohms at 4 mc and can be neglected. At 200 mc this same piece of wire now exhibits a resistive impedance of 120 ohms. If this 120 ohms were in series with a 50 ohm transmission line as shown in fig. 1, only about ⅓ of the power from the tube would reach the cable. It is for this reason that v.h.f. circuitry should be constructed with the shortest possible leads. In this manner, distributed inductances are reduced to their lowest values.

*16201 Powells Cover Boulevard, Beechhurst, New York.

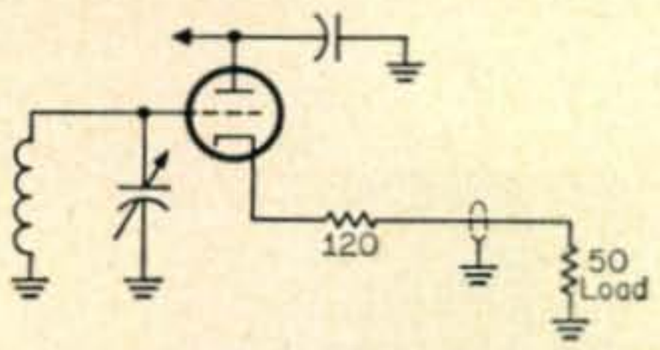


Fig. 1—The 120 ohms in series with the transmission line represents the impedance of a 4" length of #20 wire at 200 mc. About ⅓ of the power will be developed across the load; the balance of the power is lost across the 120 ohm impedance.

Distributed Capacitance

Distributed capacitance offers a similar problem. Consider fig. 2 where the distributed, or stray capacity in the coupling circuit between the two tubes is shown as C_s. It is caused by wiring capacity to the chassis, input and output capacities of the tubes, and capacity between the components and wires. At 1 mc C_s exhibits a resistive impedance of 7.8K. This value, in parallel with the 1K grid resistor, has very little effect. At 200 mc however, the resistive impedance has now dropped to 40 ohms. Now, almost no signal reaches the grid.

Corrective Approaches

By proper design of tank circuits these losses can usually be minimized. Figure 3 shows a

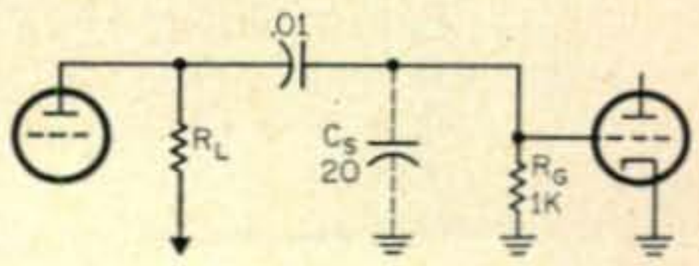


Fig. 2—Shunting effect of stray capacitance, C_s. At 200 mc the shunting effect of C_s may be as low as 40 ohms.

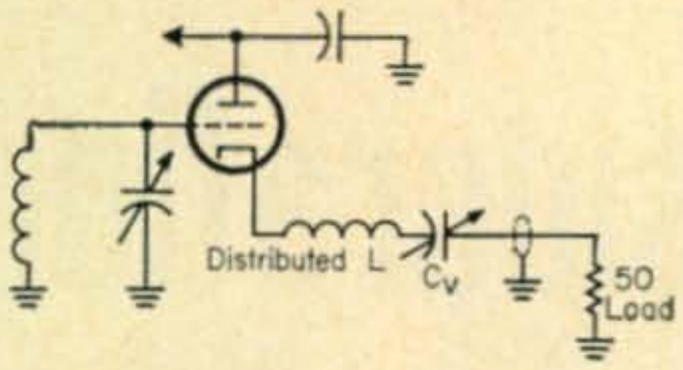


Fig. 3—A typical method of tuning out distributed inductance in a conductor.

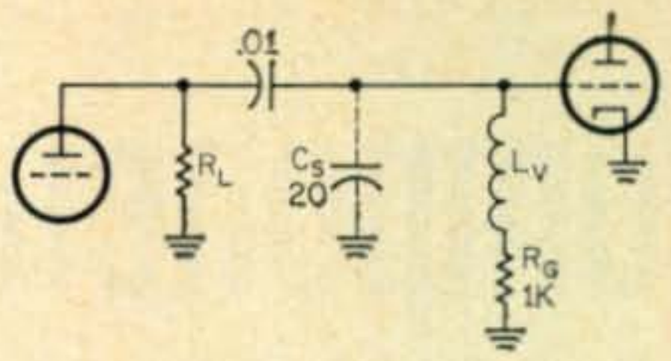


Fig. 4—The addition of an inductance in series with R_g forms a parallel resonant circuit to produce a high impedance thus overcoming the shorting effect of C_s.

conventional way to "tune out" distributed inductance. The addition of the variable capacitor C_v, forms a series resonant circuit which offers a low impedance path between tube and cable. Similarly the addition of inductor L_v, in fig. 4, is a method of eliminating the effects of C_s. In this case, a high impedance parallel resonant circuit is formed and the effect on R_g is reduced. These methods are used very often in the design of wide band amplifiers such as might be found in television video amplifiers.

V.H.F. Component Types

Another important consideration when working in the v.h.f. frequencies, is the type of components employed. At low frequencies, the components used are varied and little consideration need be given to anything other than rated values of inductance, capacitance, or resistance. At higher frequencies however, these rated values do not necessarily hold true and indeed may vary by as much as 100% and more.

Electrolytic and paper foil capacitors are only useful at frequencies up to a few megacycles or so. Above 8 mc they become series-resonant due to the large inductance of the many turns of foil used in their construction. Mica capacitors are better for high frequency use and the average types can be used up to about 150 mc. Special types are available for higher frequency use, although ceramic capacitors are almost always used, especially above 300 mc.

Several types of variable capacitors are employed for v.h.f. work. The large, bulky, low frequency types are replaced by small ceramic insulated types with silver-plated rotors and stators. These are useful into the hundreds of megacycles.

Butterfly capacitors are employed up to 1500 mc and are quite efficient. This type, due to the nature of its construction, eliminates the loss caused by the wiper contact to the rotor in other styles of capacitors. Other capacitors that find use in the v.h.f. bands are the disc and tubular types.

Above 30 mc, it becomes impractical to employ multi-layered coils as inductors for tuned circuits or r.f. chokes because of the high values of self capacity of such coils. This capacity causes series resonances and destroys the inductance of the coils. Most inductors used are single layer, wide spaced, and either air wound or wound on ferrite slug-tuned low loss ceramic forms. The air wound coil is used almost exclusively in the high power stages of the v.h.f. transmitter. It is usually constructed of large diameter wire or tubing and almost always silver plated to reduce losses. Slug tuned coils customarily exhibit high Q and good frequency stability and are employed in the low level stages of transmitters and variable frequency oscillators.

The wirewound resistor begins to loose effectiveness as the frequency approaches the 3 to 4 mc region. Due to the large amounts of inductance and capacity the windings exhibit these resistors are really only useful for power purposes. Special non-inductance bifilar wound types are produced, but they too become useless above 5 mc or so. The familiar carbon composition type resistor is the one that finds the greatest use at high frequencies. The standard ½, 1, and 2 watt resistors are useful at frequencies as high as 300-500 mc. For still higher frequencies specially designed resistors such as the carbon-film types are employed. These resistors find use in the kmc range. ■

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QTC*

(*I have a message for you)
de Stuart F. Meyer, W2GHK

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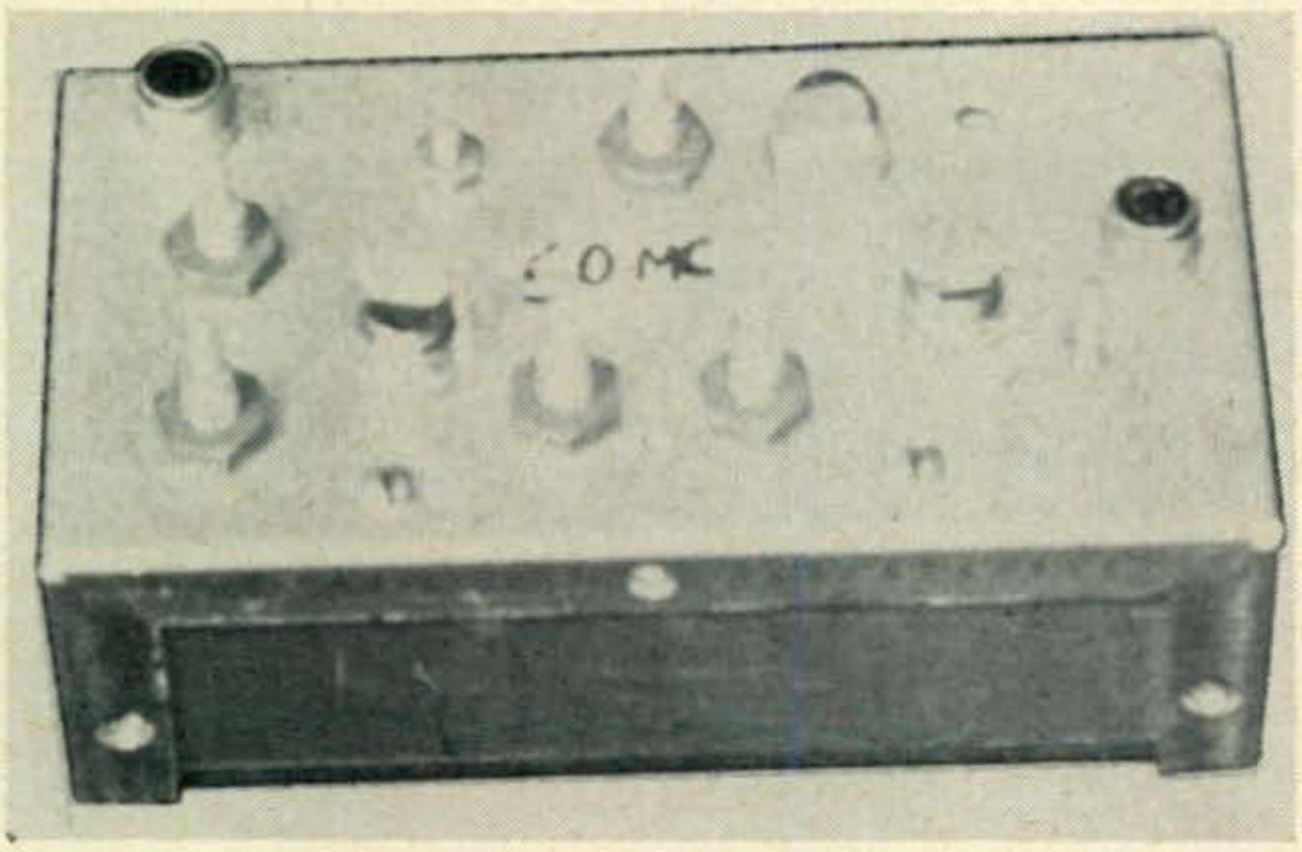
TRANSISTORIZED CONVERTERS FOR V.H.F.

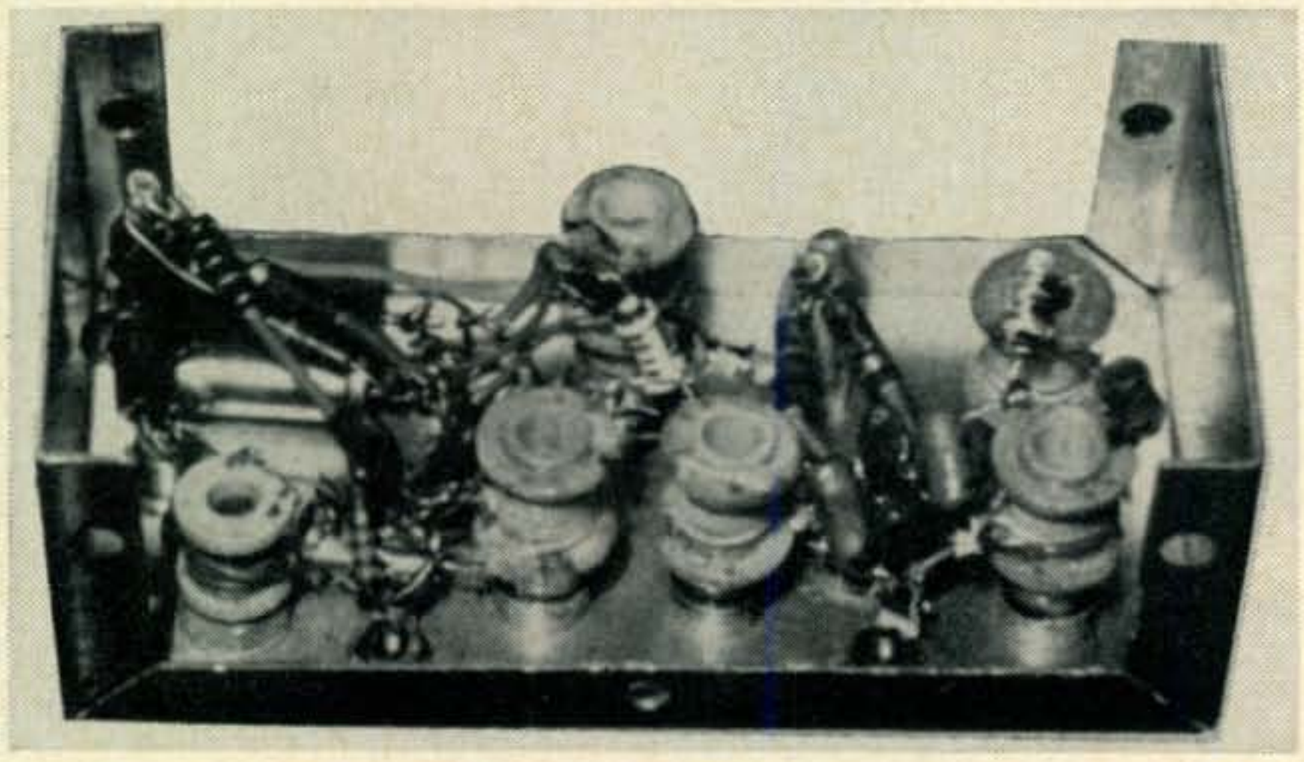
BY FRANK C. JONES,* W6AJF

Presented below are four transistorized converters. Each provides an output in the 14-18 mc range for inputs on the 50 mc, 144 mc, 220 mc or 432 mc bands.

THE use of two transistorized communications receivers at this amateur station finally led to the construction of a 14 to 19 mc band i.f. system along the same design but having a wide tuning band so it could be used with v.h.f. converters. The transistor converters for this system can also be used with a tube type receiver which tunes from 14 to 18 or 19 mc. Over a period of time converters for 50, 144, 220 and 432 mc were built and used on the air and were found to compare very favorably in sensitivity with nuvistor tube converters. The transistors will not stand as great a signal input as tubes but in general the noise figure is better.

*850 Donner Ave., Sonoma, California 95476.





Top and bottom views of the 50 mc transistorized converter. The crystal can be seen in the upper left corner of the bottom view wired directly into the circuit. The input jack is on the right.

50 Mc Converter

The circuit is shown in fig. 1 and the converter was built into a 4 × 2 × 1⅝ inch aluminum box as were the other units also. The r.f. stage, a Sprague or Philco 2N1747 transistor, has a dual circuit preselector to reduce out of band signal pick up which could cause cross-modulation with the desired signals. A total of four tuned circuits with loaded *Q* values of 15 to 20 in the 50 to 52 mc region, gives good image suppression and i.f. signal rejection.

The mixer stage has base signal input and emitter oscillator input with the i.f. output in the collector circuit. This system provides more mixer gain than is generally available with tube mixers so one r.f. stage provides plenty of overall gain.

The oscillator, a type 2N1744, or 2N1747, has a small enough bypass capacitor in the emitter circuit to provide a little regeneration for overtone oscillation at 36 mc. Different types of transistors require other values of emitter bypass capacitors ranging from 100 to 1000 mmf. The 2N1744 functioned smoothly with a 470 mmf capacitor.

The total current drain from an 8.4 or 9 volt battery is between 3 and 5 ma, so a battery switch should be used unless the main receiver supplies around 8 volts to the converter. The bias resistors in the base circuit would need different values if the supply voltage is much higher or lower. These values should be chosen so the base voltage is about 1 volt in case the emitter resistor is 1000 ohms.

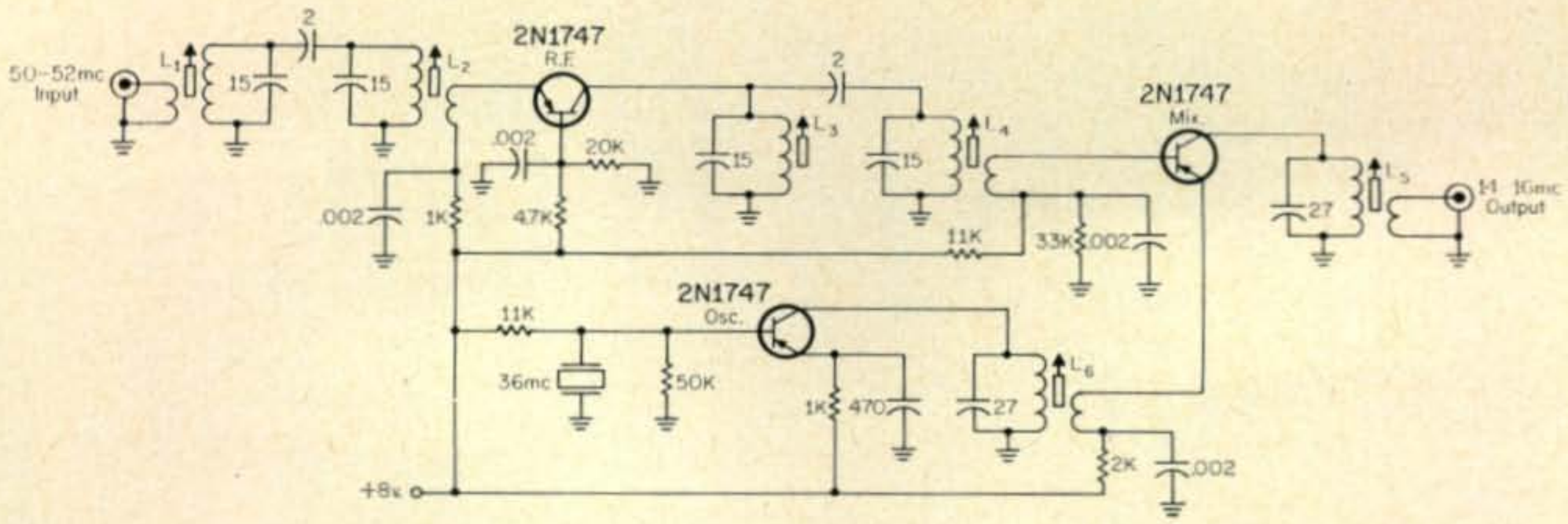


Fig. 1—Circuit of a transistorized 50 mc converter with output in the 14-16 mc range. All resistors are ½ watt and capacitors marked one or greater are in mmf, less than one in mf. Use ferrite slugs for L_1 through L_6.

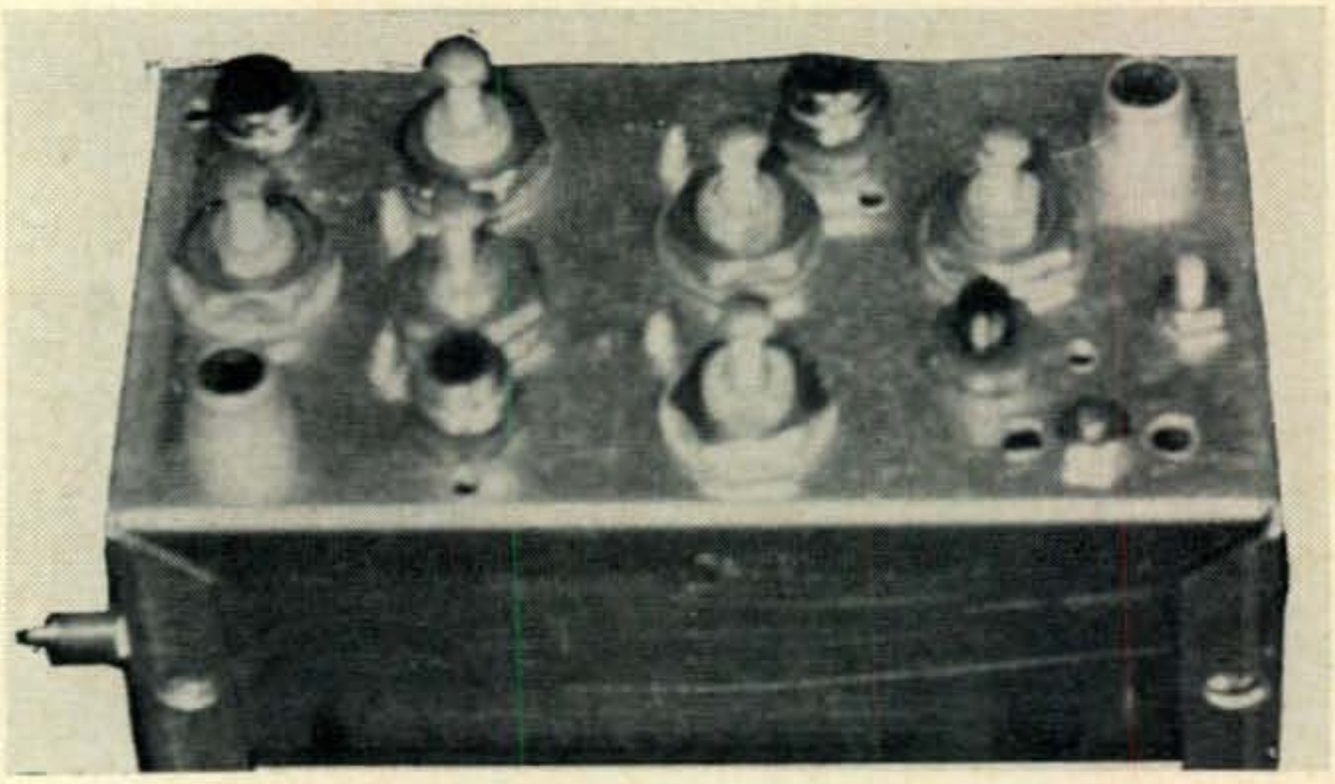
L_1—8t #22 e., ¼" long on a 5/16" dia. slug tuned form with a 2 turn primary.
L_2, L_3—8t #22 e., ¼" long on a 5/16" dia. slug tuned form.
L_4—8t #22 e., ¼" long on a 5/16" dia. slug tuned form with a 2 turn secondary.
L_5—26t #28 e., 3/8" long on a ¼" dia. slug tuned form with a 4 turn secondary.
L_6—11t #24 e., ¼" long on a ¼" dia. slug tuned form with a one turn secondary.

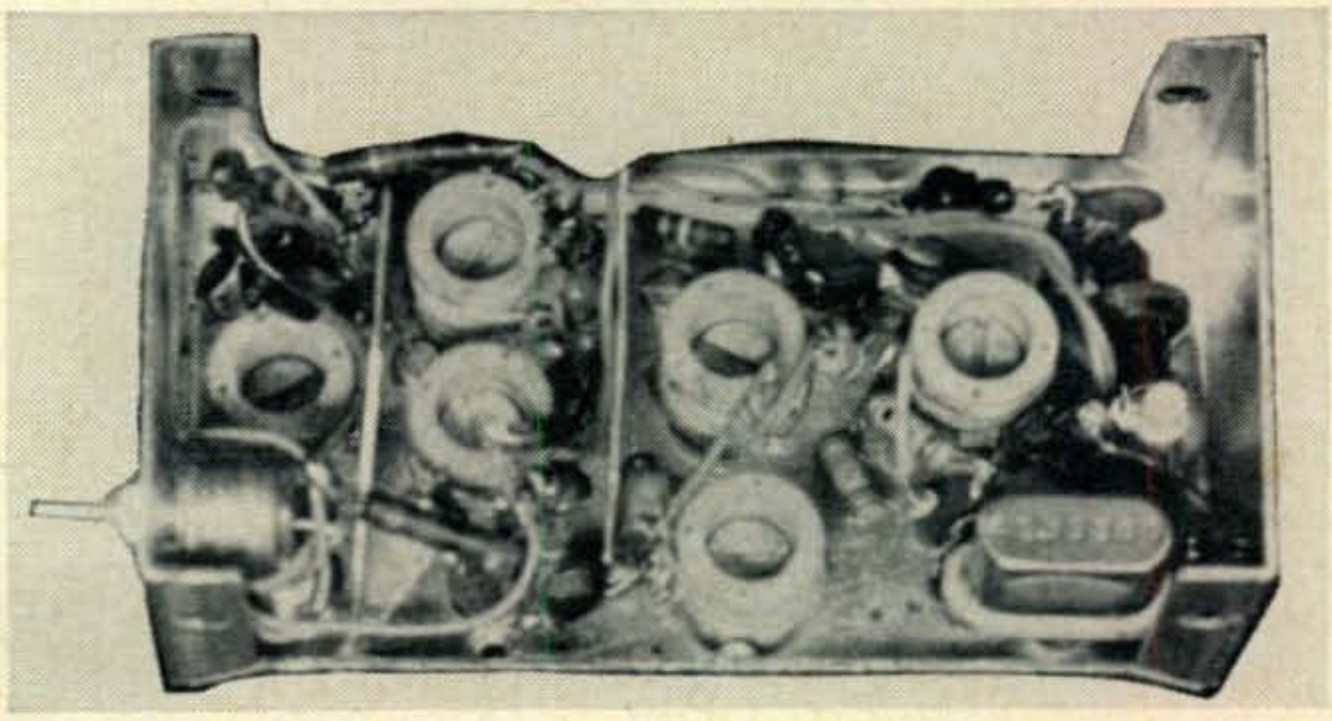
144 Mc Converter

This converter shown in the photograph and in fig. 2, like the other units, was built into a 4 × 2 × 1⅛ aluminum box. Two r.f. stages were used with a common base, emitter input circuit which is a little like a grounded grid tube circuit. The input resistance is around 50 ohms in each r.f. stage which is a little lower than for common emitter circuits where the emitter is bypassed to ground. Not all transistors work well with common base connection as some will oscillate violently. The transistors used in these converters seem to function smoothly and provide moderate gain per stage in a common base circuit which does not require neutralization. Other types than those shown in the circuits may oscillate too easily and should be used in neutralized common emitter circuits.

The circuit of fig. 2 shows five tuned circuits which are loaded to a working *Q* of 15 to 20 except for the input circuit which is lower. Best n.f., noise figure, results when this circuit is operated at lower *Q* values. The mixer circuit uses a pi-network tuned to about 16 mc with low *Q* so as to cover 14 to 18 mc. About three feet of RG-59/U coax cable is needed between the converter and the 14 to 18 mc i.f. receiver in order to furnish the required output capacitance and impedance step-down from the mixer collector to the i.f. receiver input.

The overtone crystal oscillator with a 43⅓ mc crystal, furnishes output at 130 mc using a single transistor. The emitter circuit must resonate at a frequency between 43⅓ mc and the fundamental of 14.4 in order to ensure overtone oscillation at 43⅓ mc and tripler action in collector circuit. The 2 to 3 microhenry r.f.c. will resonate in the required range with from 10 to 20 mmf of capacity across it. The transistors shown in fig. 2 worked best with 10 mmf but other types tested in this circuit were too regenerative and required 20 mmf for proper oscillation. The circuit is actually regenerative at 130 mc since the emitter bypass capacitor is so small. This is an advantage





Top and bottom views of the 144 mc converter. The bottom view shows L_2 and L_3 shielded by vertical brackets on both sides. The miniature R.F. GAIN control is on the left chassis flange; the input jack is on the left side.

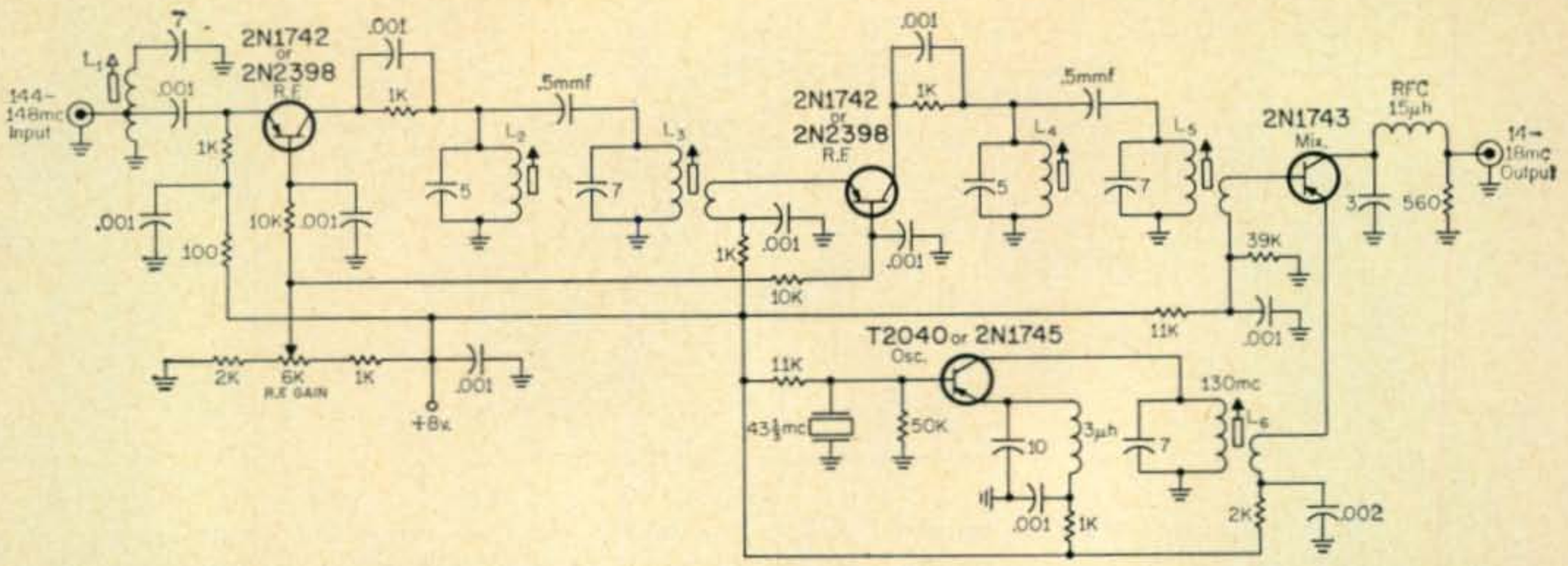


Fig. 2—Circuit of the 144 mc converter. All resistors are ½ watt and capacitors one or greater are in mmf, less than one, in mf except where otherwise noted. All coils are 3t #20 c., ⅛" long, wound on ⅜" diameter brass slug tuned forms. Coil L_1 is tapped at one turn; L_3, L_4 and L_5 have one turn secondaries. The ½ mmf coupling capacitors are gimmicks formed by approximately three twists of hook up wire.

which permits weak oscillation at 43⅓ mc and very low r.f. current through the crystal, factors which result in excellent frequency stability. The output at 130 mc is sufficient to operate the mixer stage.

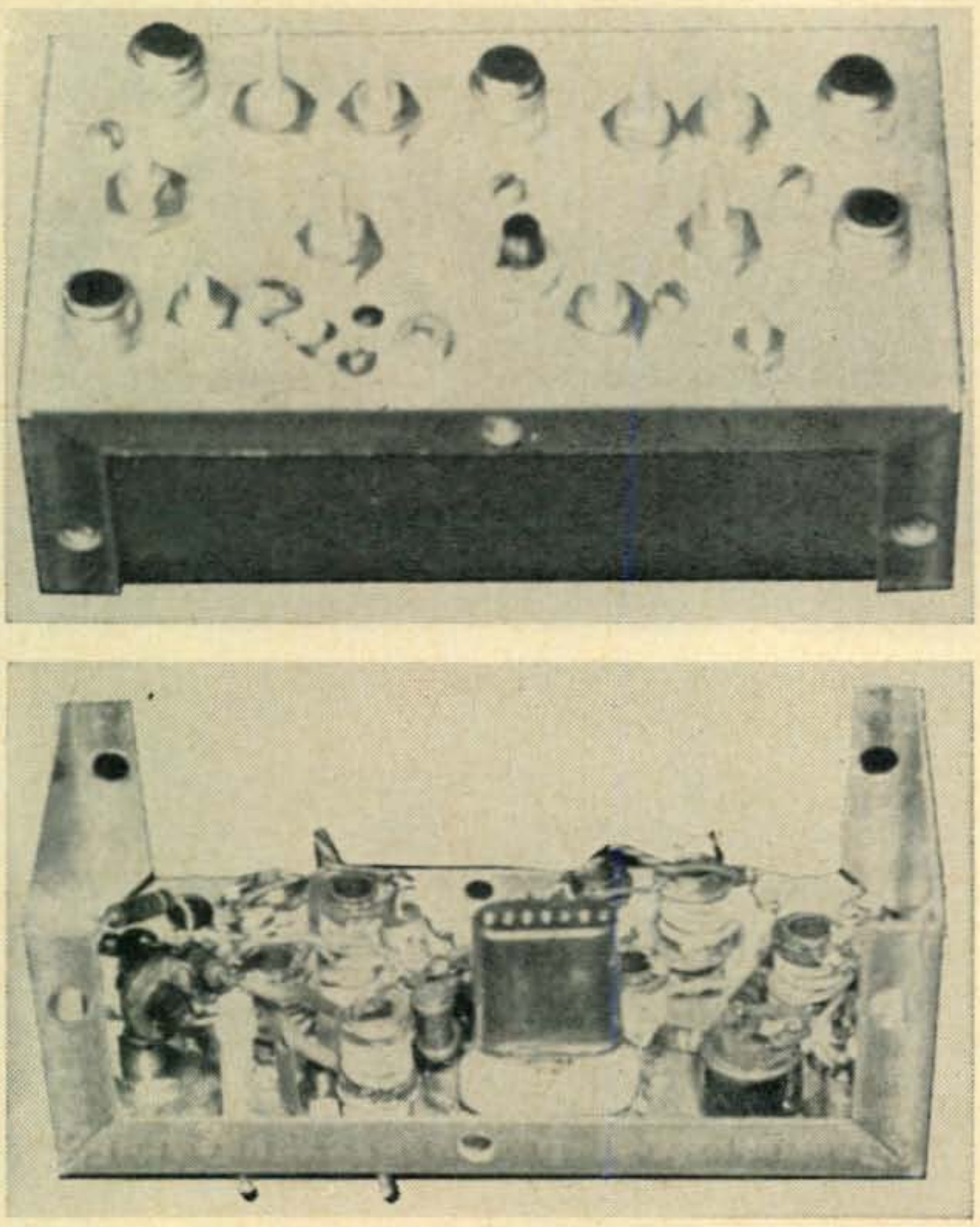
Figure 2 shows the use of a manual R.F. GAIN control which is of the "forward" type. This means that the base bias is varied so as to increase transistor current for a reduction of gain. The gain is reduced because the resistor in the collector circuit takes up more of the d.c. supply voltage as the current increases. The voltage drop across the emitter and collector resistors causes a gain reduction as it increases. "Forward" gain control is many times better than the more usual form where the collector current is decreased. The cross-modulation problems are less and the n.f. does not increase as fast at lower gain settings. Strong signal overload problems are reduced.

220 Mc Converter

Figure 3 and the photographs show the details of a 220 to 225 mc band converter using Sprague 2N1742 or 2N2398 transistors. The latter cost a few cents more and are better at the higher frequencies, having about one db less n.f.

The circuit, except for *LC* values, is quite similar to the 144 mc converter. The overtone oscillator is a little different since it uses a tuned circuit in the emitter and the crystal is connected from base to emitter rather than to ground. The oscillator behaves somewhat like a Trite tube oscillator with 68⅔ mc oscillation in the emitter and base circuits and 206 mc tripling action in the collector-emitter circuit. It is quite effective with some types of transistors and tricky with others. Some transistors function with overtone crystals better in other circuits or with different *LC* ratios in the emitter lead.

The builder should expect to do some experimenting when working with overtone crystals and multipliers, especially when using crystals in range of from 20 to 70 mc. Different manufacturers prefer third, fifth and seventh overtone crystal design. The writer ran across one ninth overtone crystal which



Top and bottom views of the 220 mc converter. The ½ mmf gimmick capacitors coupling L_2-L_3 and L_4-L_5 are clearly visible. The minature R.F. GAIN control is in the front right corner as is the input jack (bottom view).

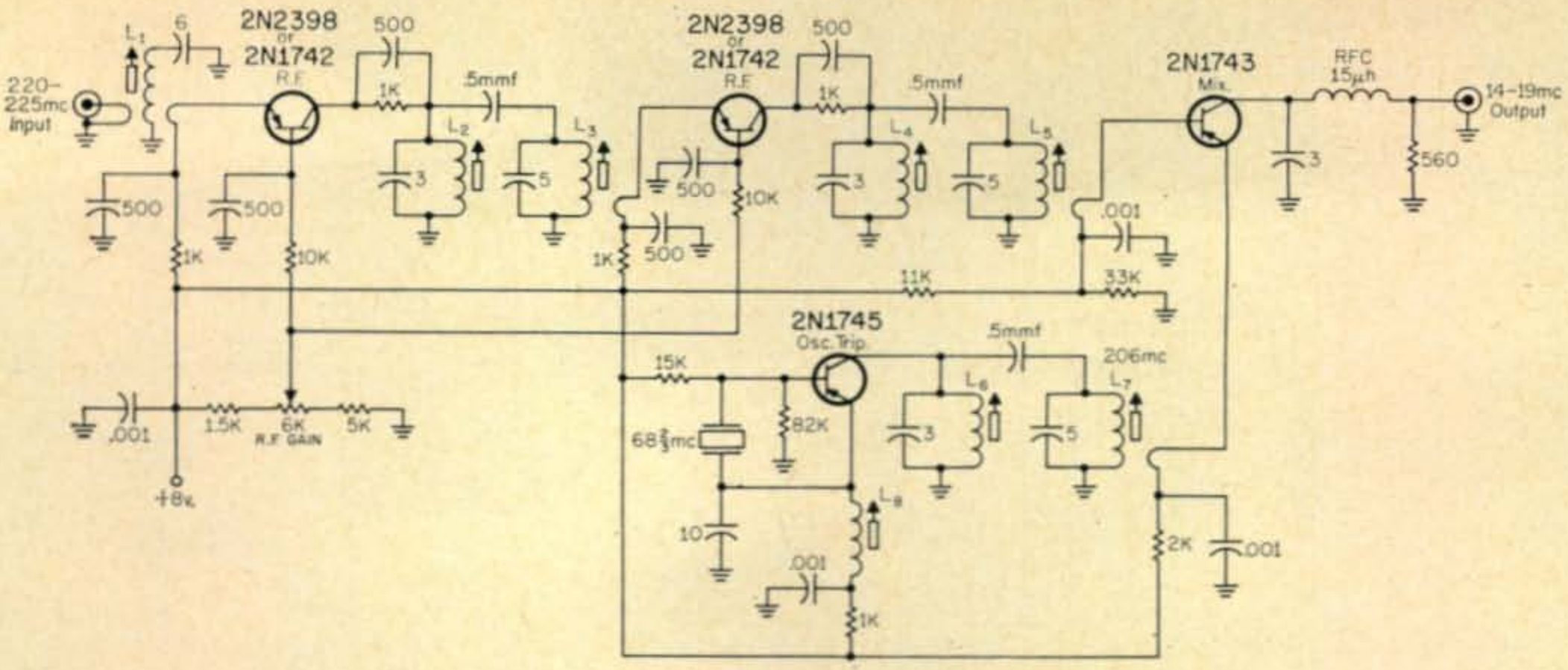


Fig. 3—Circuit of the 220 mc converter. All resistors are ½ watt and capacitors marked one or greater are in mmf. Capacitors marked less than one are in mf unless otherwise noted.

L_1 through L_7—4t #20 c. or e., ¼" long on ¼" dia. brass slug tuned forms. All coupling loops are 1 turn (L_1, L_3, L_5 and L_6).

L_8—13t #24 e., ⅜" long, ¼" dia. on brass slug tuned form.

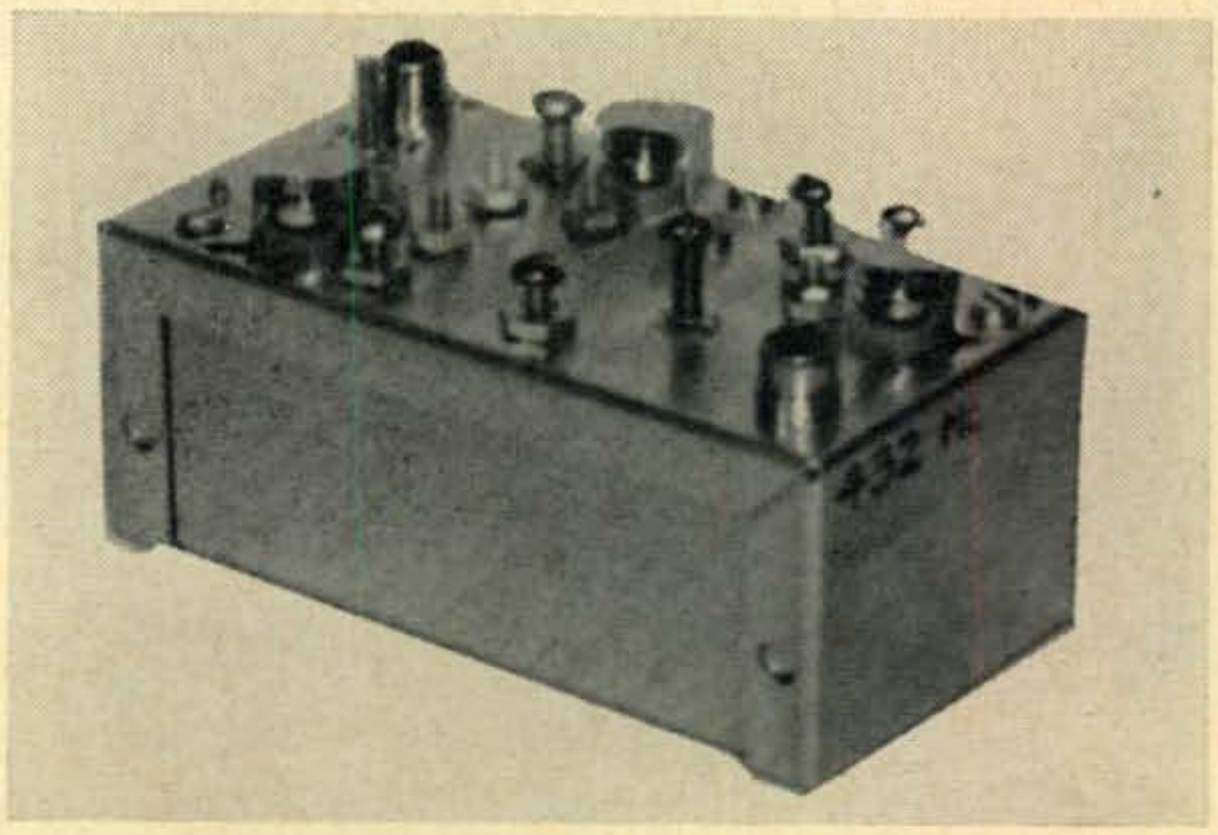
was designed for output well above 100 mc. This all means that some oscillator circuits may require variation in some of the *LC* ratios, especially for different types of transistors.

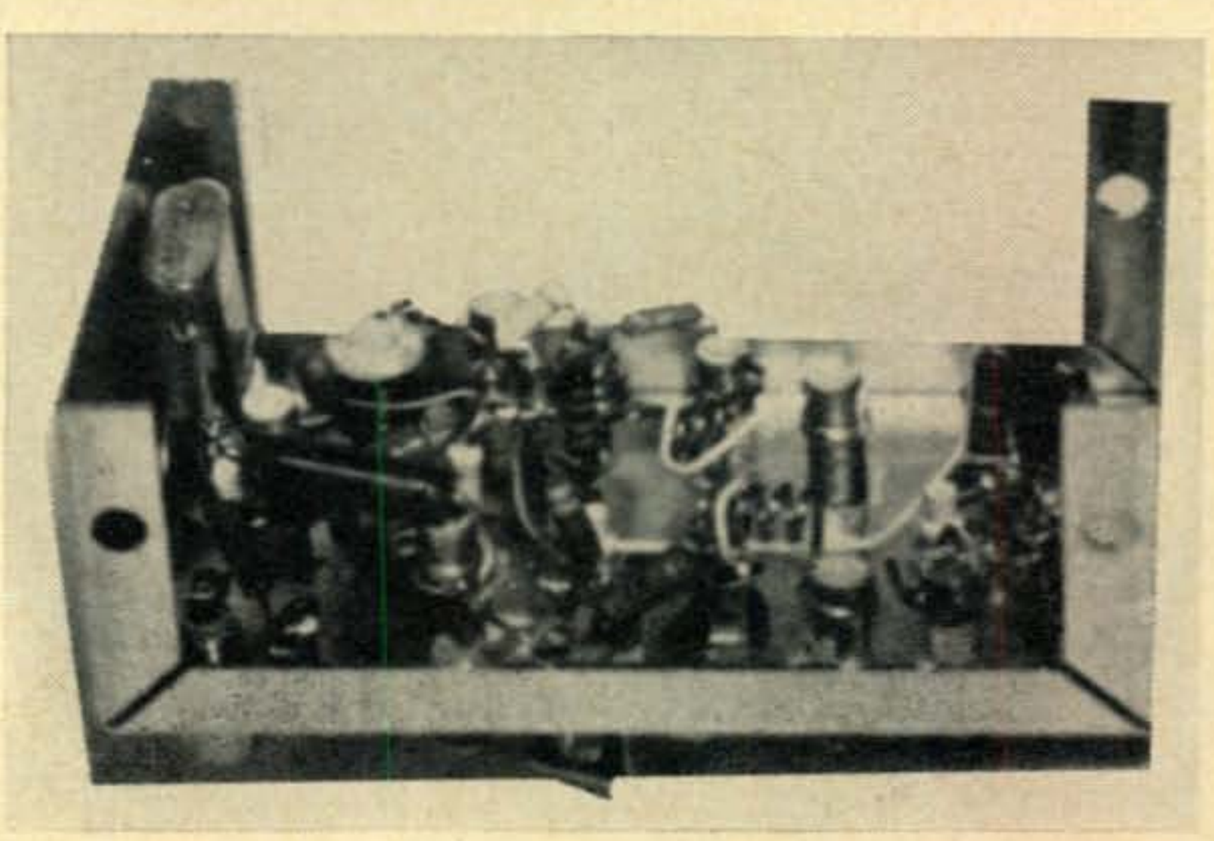
Either n.p.n. or p.n.p. transistors which oscillate at several times the overtone crystal range, may be used as oscillator-multipliers if proper battery supply polarity and base bias resistors are used. The p.n.p. units always have the base at a slightly less positive bias (or more negative) than the emitter voltage to ground and vice versa for n.p.n. transistors. Either positive or negative grounded battery supply can be used with either type of transistor. For example, with a negative grounded supply the p.n.p. transistors have their collectors going to ground and emitters to plus battery feed, while with n.p.n. transistors, the collectors go to plus battery feed and the emitters to ground.

The 220 mc converter in fig. 3 uses forward gain control on the two r.f. stages. This control can be mounted in the small aluminum box or elsewhere as desired. The 206 mc oscillator circuit shows two tuned circuits used to reduce undesired frequencies in the output to the mixer stage. If the base resistors are varied a little to reduce strength of oscillation and harmonic output, only one collector tuned circuit is needed in most locations where 220 mc reception is desired.

432 Mc Converter

The 2N2398 transistors work quite well at 432 mc as r.f. amplifiers and mixers or even as oscillators. Both Sprague and Philco transistors have been used in all of these converters with no noticeable difference in operation. Common base r.f. amplifiers work very well at 432 mc although some r.f. stages require a small 1 to 5 mmf variable capacitor connected across the coax jack to ground to arrive at stable operation. Usually the





Top and bottom views of the 432 mc converter. The input jack is on the right side (top view) and the output is the left rear corner.

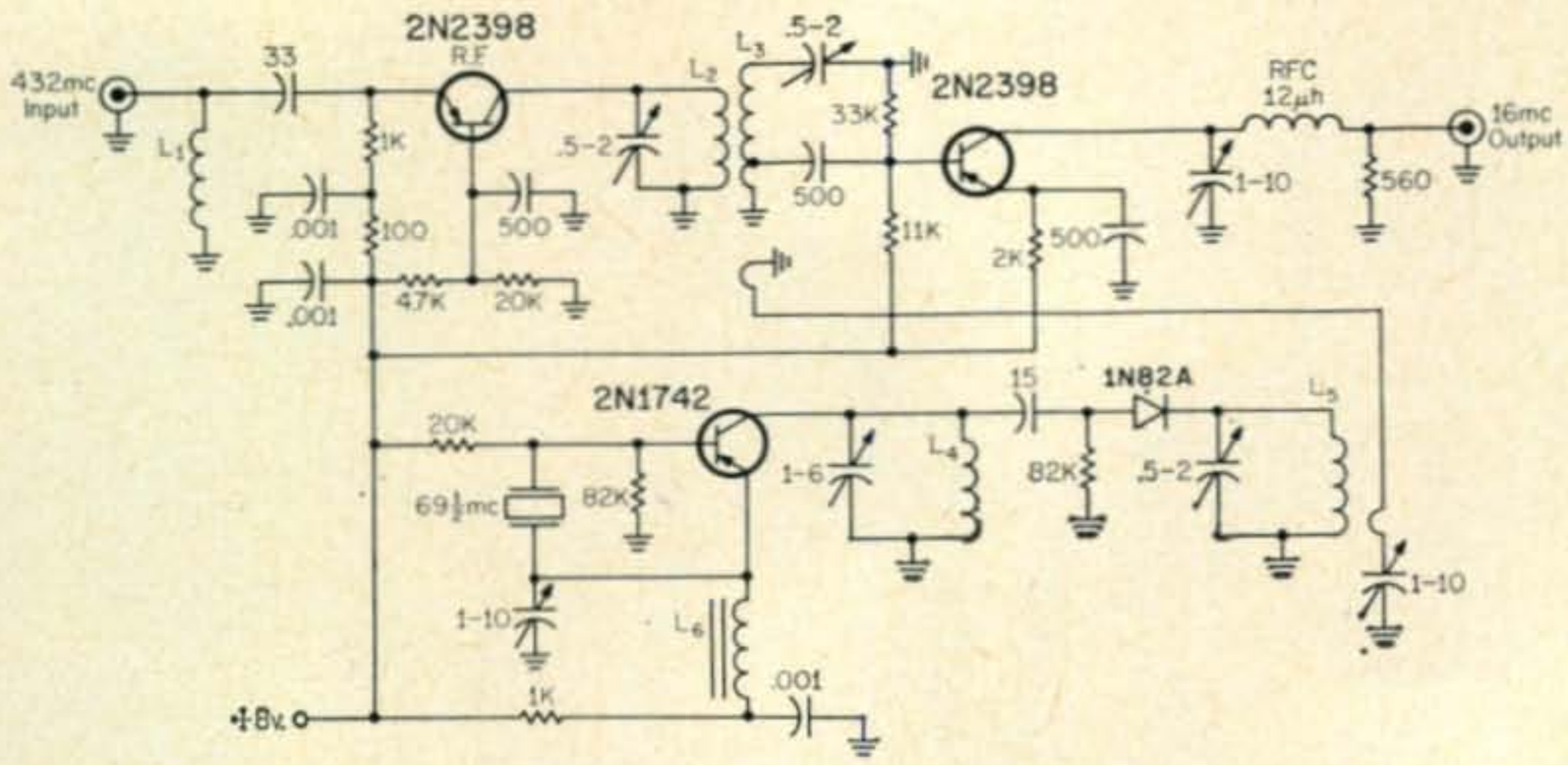


Fig. 4—Circuit of the 432 mc converter. All resistors are ½ watt and capacitors marked one or greater are in mmf. Capacitors marked less than one are in mf. Coils L_2 and L_3 are coupled end to end, ⅛" apart. Indicator L_6 is wound on a ferrite form coded white (v.h.f. core). L_1 through L_6 are wound on ferrite slugs.

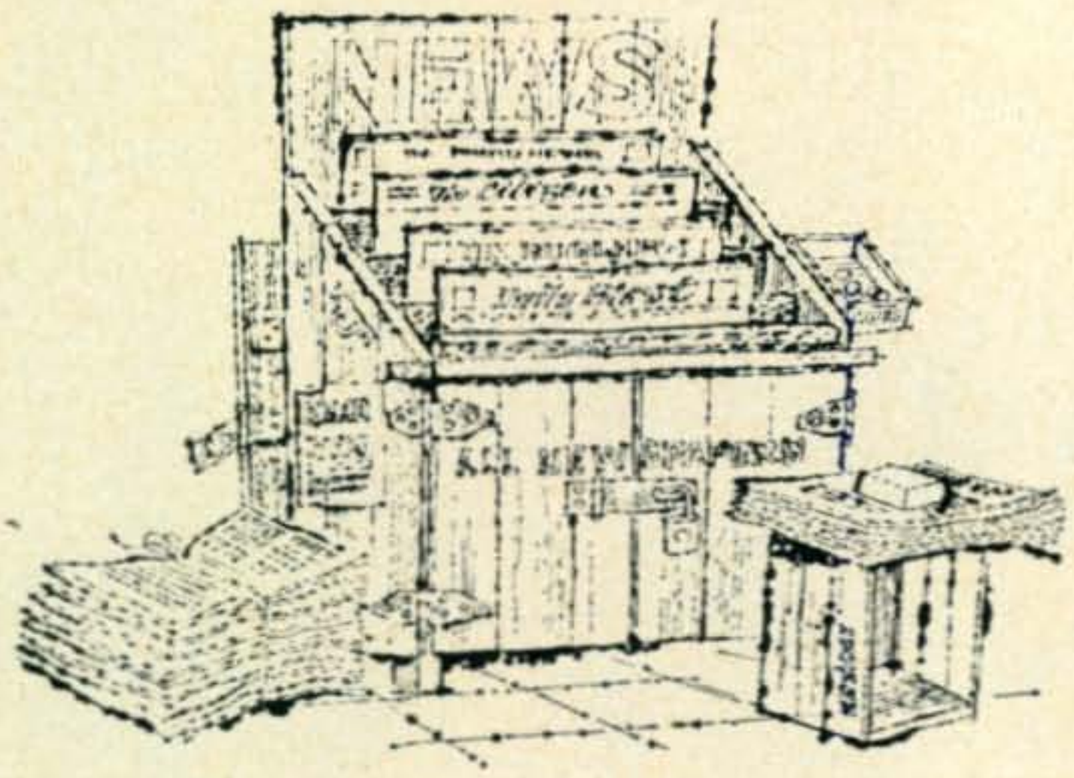
L_1—6t #20 e., ⅜" long, ⅛" dia.
L_2—3t #18 e., ¼" long, 3/16" dia.
L_3—4t #18 e., ¼" long, 3/16" dia.
L_4—4t #18 e., ¼" long, 3/16" dia.
L_5—3t #18 e., ¼" long, 3/16" dia.
L_6—11t #22 e., ⅜" long, ¼" dia.

antenna loading will make these common base circuits stable enough to operate well below the oscillation point. Some r.f. regeneration helps on weak signal reception on these higher bands where the transistor gain begins to fall off.

Either common base or emitter circuits function equally well as mixers. The arrangement shown, with either inductive coupling between the 416 mc oscillator circuit and the 432 mixer circuit or link coupling as shown in fig. 4, have been used successfully. The link circuit inductive reactance can be tuned out with a 1-10 mmf piston type variable capacitor.

The oscillator circuit uses an overtone crystal of 69⅓ mc for 16 mc i.f. or 69⅔ mc for 14 mc. The particular crystal used in this converter oscillated better with an adjustable emitter capacitor, a 1 to 10 mmf piston type unit and a slug tuned emitter coil. The crystal supplies 208 mc collector output energy which was then multiplied by a 1N82A diode to 416 mc. Low capacity, fast

[*Continued on page 102*]



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Are you young, vigorous, in great shape, able to spare three months, able to speak fluent Spanish, a holder of a General Class license, and most of all LOOKING FOR ADVENTURE?—then read on, this is for you. Timid souls are excused.

THE Amazing Randi, a famous late-nite radio personality, is now organizing a three month expedition from Ecuador on through to Peru in order to visit an ancient city buried deep in the Jungle. The trip will start the end of April, after the rainy season and last through July. This is not a DXpedition going some place and just operating, but a chance for some ham to be a vital part in providing communications and a working member of an adventurous group that will spend three months crossing one of the most rugged parts of the world.

You will travel by train, truck, mule and mostly by foot. It will be a rough trip but certainly rewarding. You will return with enough tales to fill a book and loads of souvenirs. The potential for the right man is unlimited. Its the chance to leave the humdrum everyday things behind and to have the kind of experience most men dream about and very few ever get a chance at.

Coverage of the trip for magazine and TV use has been provided, and most of the journey will be recorded on film.

If you have ever imagined thrashing through a jungle with a machete, climbing mountains, crossing deserts, beating Don Miller to a remote operating position, loading pack mules and lots of outdoor living, here's your chance. Arrangements are now being made for radio equipment and supplies. All you need is a willing spirit, some personal expense money, enough time, and the basic qualification to have one of the most exciting adventures of your life.

If you think you qualify, then write a short letter about yourself, enclose a snapshot and mail to The Amazing Randi, 51 Lennox Ave., Rumson, New Jersey 07760. Include your phone number and availability for an interview. ■

The New Amateur Word Game...

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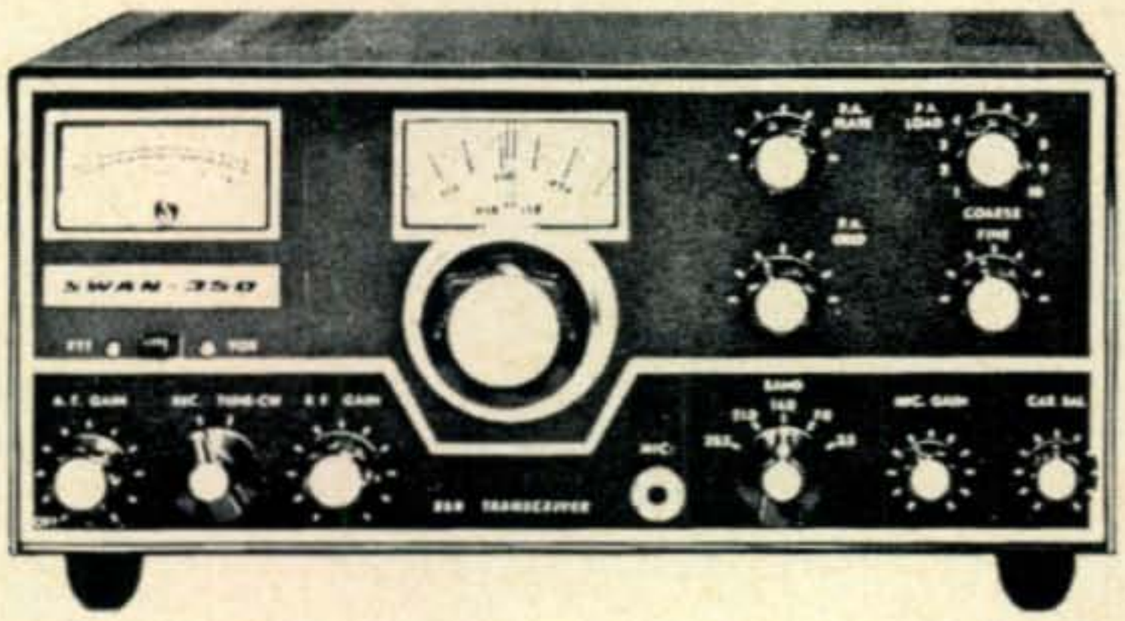

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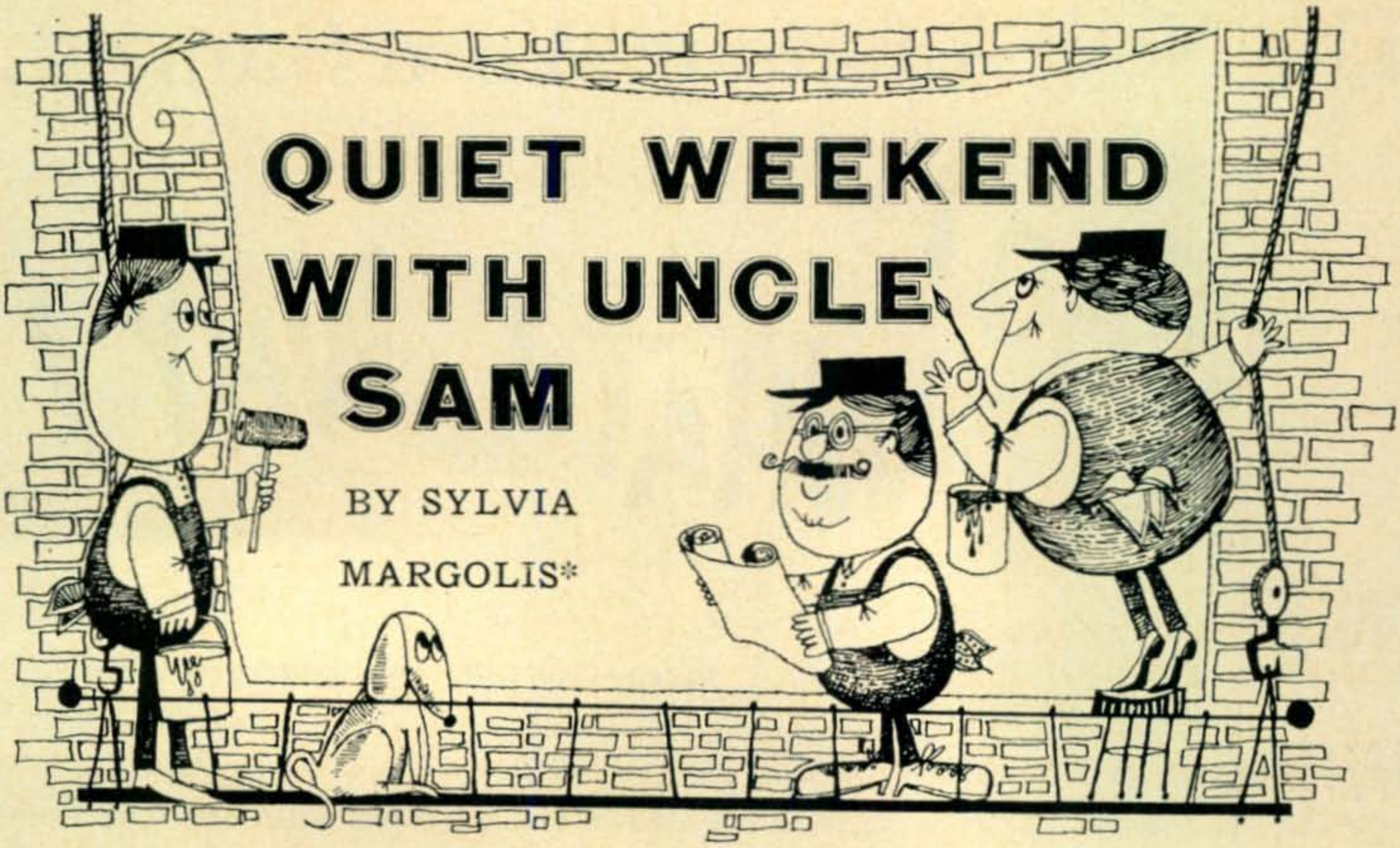
For further information, check number 2, on page 110

QUIET WEEKEND WITH UNCLE SAM

BY SYLVIA MARGOLIS*



"THE impossible we do today. Miracles take a little longer."

So, when the idea was tossed onto the Committee table to organize a Hamfest on a United States Air Force Base in Britain, the project was thought at first to be about as feasible as this DXpedition to Rockall we keep hearing about. The U.S. Forces in Britain, like all other armies of occupation, keep themselves to themselves, staying within the safety of their own compounds and emerging to fraternize with the natives only when the General so commands, and that with the eagerness and spontaneity of a Top DXer being forced by TVI onto 75 during the World Wide Contest.

The obstacles were many and formidable. The Americans had first to be convinced that 1776 was a long time ago and that British radio amateurs were a reasonable security risk. Then an attractive QTH must be found with space for a couple of thousand people and their cars, easily accessible for a large urban area, with adequate catering, picnic and toilet facilities.

One of "Ours" happened to have some official business at 3rd Air Force Headquarters, where he mentioned casually that a combined Anglo-American event would not only be a significant contribution to Anglo-American friendship, but that it would offer the then enforcedly silenced American radio amateurs in Britain the chance to see and hear, if not to operate, amateur radio again for a short while.

"Seek and ye shall find; ask and it shall be given ye!"

One of "Theirs" conveyed the wisp of an idea to a Top Man at 3rd A.F. Headquarters, then it penetrated higher still, until it got just about as Top as it could. Qualified approval began to filter down again, not committing themselves, mind you, but kind of hinting that all that tea they threw into Boston Harbor had at least sunk decently into muddy obscurity.

At last we got the word and the word was YES!

Among the sites offered was one at the U.S.A.F. Transmitting Base at Barford St. John, near Banbury, in Oxfordshire. This old R.A.F. airfield was chosen because it was near the geographical center of England, in lovely, very rural country, close to the beautiful Cotswold region. There were acres of clean, short grass for parking and picnics.

The focus of the Hamfest would be the old R.A.F. Control Tower, of blessed memory, now used only to house the Base M.A.R.S. equipment. It would have been a pretty and romantic notion if this had been one of the famous R.A.F. Battle of Britain stations, or perhaps one which had been used by the massive U.S. bomber forces during World War II. But Barford had been merely a training station and its only claims to distinction were that the first ever jet plane to fly in Britain had made a forced landing there and that the film "Twelve O'Clock High" had been shot around the base, starring Gregory Peck, which fact alone was enough to imbue it for me with eternal glory.

Once things started to roll we could see we were going to have ourselves a ball. The U.S.A.F. came up with all kinds of generous suggestions for the entertainment, succour and titillation of the natives. Yes, a pioneer party could camp on the site the night before, to set up the deal. Yes, antennas and power for the Hamfest stations would be available. Yes, American catering could be arranged, with hamburgers, hot dogs, watery beer and Coke ad lib, provided by AFEX mobile canteens. What kind of entertainment would be acceptable? A drill display team? Certainly. Baseball match and go-

*95 Collinwood Gardens, Clayhall, Ilford, Essex, England.

karting? Sure thing. Conducted bus tours to the transmitter halls? It shall be. A party the night before for the organizers? Welcome!

We were in business!

It remained only to publicize the event. The Amateur Radio Mobile Society, whose project this was, was never an organization be reticent about its achievements. "NEVER BEFORE IN THE HISTORY OF AMATEUR RADIO . . . A TRIUMPH OF ANGLO-AMERICAN COL-LABORATION . . . MEET THE AMERICAN AMATEUR ON HIS OWN GROUND . . . A DAY TRIP TO THE U.S.A. . . . AMATEUR RADIO MILESTONE . . . AMERICAN BEER . . . ! Madison Avenue had nothing, but nothing, on us.

We were onto a splendid racket. To the Englishman, America is one of two things. She signifies glamor, for two generations have grown up enjoying Hollywood and its products. Or she represents a challenge to those Englishmen, and there are not a few of them, to whom Uncle Sam is a brash, noisy, oversize, indecently successful relative, but a relative all the same! To both classes of Limey, Barford was to be a novelty and a huge attraction.

On a June Saturday in 1960, we first saw Barford. Over the vast expanse of the airfield, the antenna farm flourished—big antennas, little antennas, log antennas, discones, rhombics,—enough antennas to make a radio amateur blench with envy. They told me that the little antennas would grow into big ones, because this was good farming land. This figured.

Everything was silent and seemingly deserted, no sentry at the gate, no flags flying. We drove into a quiet you could feel and taste in the bland, for once, evening air.

Then that peace was shattered by a stentorian voice which exploded all round us:

"G3NMR proceed towards the Control Tower!"

We proceeded.

"AND HAVE A BEER!" commanded Big Brother.

On the balcony of the Control Tower, playing with the public address system, stood a burly man wearing a shirt that would have been left over after a Rummage Sale and Tyrolean hat with a feather, which no self-respecting Rum-mage Sale would have accepted in the first place.

The author, temporarily taking charge of the situation, as the reception desk is set up.

The welcoming sign at the entrance to the site of the famous Barford rallies.

This was Their Man at Barford, K7LKS, Major (later Colonel) Peter Kravchonok, U.S.A.F.

It was Peter who established many of the de-lightful Barford traditions. Asked why he dressed so unconventionally, he said: "HELL! This is my HAM uniform!"

For power supplies this human dynamo used an exclusive American current, called Schlitz-Budweiser, to which he promptly introduced us and with which we expressed ourselves pleased on the whole, although it did seem un-British to drink the funny stuff cold. Beer should be strong enough to drive a 4-400, dark enough to write your log in and as warm as a final during a contest.

All day Peter kept us going with his special power supplies. We certainly needed them. Despite our English genius for procrastination, like postponing the decision about what 2 meter equipment to use, so that we found we had all come without 2 meter equipment for the Ham-fest station and had to adapt somebody's mobile rig for fixed operation—soon the whole Base began to wake up. Talk-in stations were installed and activated, notices set up to tell people im-portant things, like where toilets and power sup-plies were to be found. The Red Cross had been invited to do first aid and showed themselves ready to cope with any emergency, from r.f. burns to a breach presentation.

When we weren't taking in Peter's power sup-plies, we drank tea. American amateurs, reluc-tantly silent during their stay in Britain, homed in on the Base, content just to be in the beloved presence once more. We talked with them of the happy time, the Green Pastures, when they might be able to operate in U.K., but in 1960 this

If you look close that's K9AWX climbing the tower with K4HKX and G3KVF standing on the Barford control tower.

seemed as remote as a manned flight to the moon.

The Sunday dawned dull, with a mean, chill wind, a typical English June morning. The site looked dismal, bare and oddly make-shift. What zany scheme had we undertaken? You could fool some of the people some of the time, but would the people even *come* to be fooled on this empty field in the middle of England? And if they did come, what would there be to attract them? We were very depressed, so we made a cup of tea.

As the kettle came to the boil, all the Americans in sight stiffened to attention and a big Caddy pulled up at the Control Tower. It was the Colonel.

The Colonel wasn't a radio amateur, but you couldn't have a nicer man. We were introduced and everybody said the correct things and everybody hoped the sun would come out and that the customers would flock to Barford and how clever it was of the Colonel to have British ancestors who crossed over on the next boat *after* the Mayflower. So upstart, somehow, to have been in the first boat!

Politely the Colonel accepted a cup of good, English tea, hot, strong, with milk. He sipped and it was clear how he had earned that shining brass chicken on his shoulders. Not for nothing the years of training and discipline. Control as stiff as his beautiful uniform, he demonstrated all those splendid qualities that made him, and the Service he served, what they are. As taxpayers you would have been proud of that Colonel!

Then somebody shouted and pointed at the sky. There was a patch of blue "big enough to make a cat a pair of pants," sure herald of a fine day. As if rent by some benevolent ham deity, the clouds floated back to reveal a sky in that unsullied blue which is so precious in England because it is so rare.

As the sun came out, so did the flags. Side by side, proudly, in matching colors, the Stars and Stripes and the Union Jack were hoisted, happy and glorious, whipping and cracking in the stiff breeze, while the loudspeakers blared out the "Washington Post." It was a magic moment and nobody who was there will ever forget it. We had a Hamfest!

The remarkable statistics of that wonderful day made history and are filed away in the magazines. And we began at once to plan the Second Barford. The U.S.A.F., delighted with the experiment, now offered us more ambitious amusement —the mixture as before, plus the certain box-office draw of the U.S. 3rd Air Force Band.

By now we knew that, for the hams themselves, no other provision was necessary than the opportunity to meet and gossip. Contests for home-brew gear, safe installations, frequency measuring or df'ing meet, in Britain, with limited and dilettante response. In Europe Hamfests are fiercely competitive, with every contest a grave and vicious struggle to win. But most U.K. citizens vehemently deny that they belong to Europe.

So it was for the wives and children that we learnt to supply the entertainments—contests, raffles, tombolas, hairdressing and beauty shows, fashion events, guess the weight of the cake, pony rides—anything to break through that awful XYL BARRIER and leave the wives as content at the end of the day as their enchanted husbands. A unique feature of Barford, which did much for its public relations, was that a part of the proceeds was always donated to charity, sometimes a radio charity, once the Kennedy Memorial Appeal.

Barford had its critics. One complaint was that it was too "high-powered and chromium-plated," a comment that was seized on with joy by the organizers and used in subsequent publicity. Soon the event became established as one of the biggest and most enterprising amateur radio occasions this side of the Atlantic. Others tried to copy Barford, on other American or British bases. Sometimes they started with better facilities than we had, but none of them had the zing of Barford. Nobody seemed to be able to take a great, bleak, half-derelict airfield, dozing with its generation-old memories, galvanize it and turn it, once a year, into a bustling, king-size picnic.

Now the prize presentation was a fixed feature in the diary of the Mayor of Banbury; the Red Cross provided first aid demonstrations and "kiss-of-life" instruction; an elaborate souvenir program was produced and sold out each year;

a tombola, with hundreds of prizes, lured and tempted dollars and pounds out of the visitors. The 3rd Air Force Band appeared twice again, alternating with a popular and immensely noisy Beat Group.

The British flocked in from all over the country. So did the Americans. From as far away as Mildenhall and Burtonwood they would drive, with their families, half a day over appallingly congested Sunday roads, to take in the "International Hamfest." By 1962 it was tradition for anybody with tent or trailer to make of Barford a weekend event, helping to set up the Hamfest on the Saturday and enjoying a barbecue party that night. Dawn Reveille on Sunday was usually marked by a public-spirited reveller who went round each family, solemnly dispensing Alka-seltzer.

A new attraction was introduced—the biggest amateur communications trade show outside London, housed in an aircraft hangar.

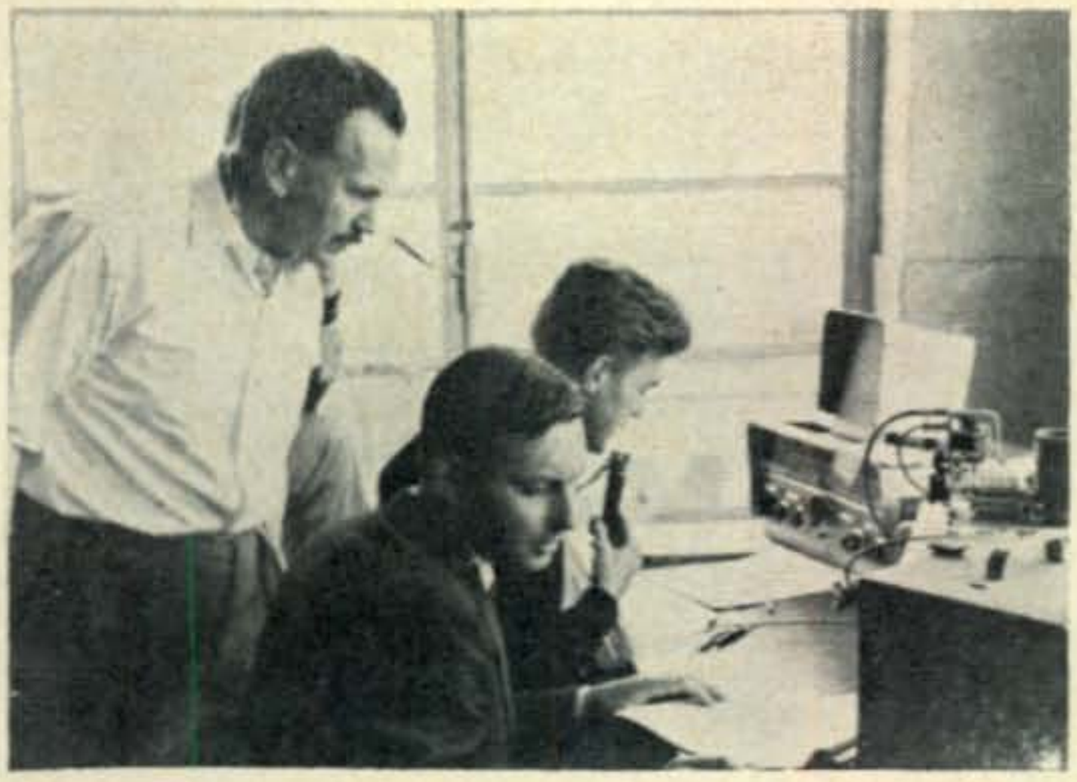
Only one thing was still missing. Still the Americans weren't allowed to operate the elaborate Barford stations, now functioning on 2 and 4 meters (there is no 6 in Britain), on the h.f. bands, using the existing M.A.R.S. antennas and British commercial s.s.b. gear, and on Top Band, on which 75% of British amateurs, and 90% of the mobiles, operate.

But in 1964, a triumph of lobbying and nagging, permission was obtained for licensed American amateurs to operate the Barford stations for the period of the Hamfest. First man to take advantage of this bonanza was K4RUT, Sgt. Bill Snedigar, U.S.A.F., fun-loving member of the Barford Committee, who operated without sleep or significant intake of food, for 48 hours solid. That this concession was given on July 4 was sheer coincidence, but a remarkably happy one!

At the 1966 Barford Americans were able, for the first time, to take their place as equals alongside their British friends, with their own British licenses, in the new G5+3 series.

The 1966 Barford was noteable, too, because there was a complete local power failure, so that there very nearly wasn't a Seventh Barford at all. Here the British ability to flourish in adversity (with American aid, naturally!) was dramatically demonstrated.

Whilst emergency gangs from the Electricity Board charged round the countryside, desperately digging things up and putting them back again, in a vain attempt to find the break, Their Man (1966) at Barford, Lt. Paul Casper, U.S.A.F., K4HKX, and well-known DXer Bob Lane, WA6ZIQ, who had just dropped in from Mildenhall, 150 miles away, remembered the existence of a 150 kilowatt portable generator a few miles away. It weighed four tons and went straight through the road when they started to tow it away. They pulled it out with a mobile crane and, trusting there was no weak bridge or travelling circus along the narrow, winding lanes to Barford, pulled it, at 5 miles an hour, to the site. It dispensed so much power that the whole Base had to have its lights on all day to use up the surplus! But Barford was saved!



A view of the "Talk-in-Station." Rowley Shears, G8KW, President of KW Electronics Ltd. the largest British amateur communications manufacturers, watching the performance of some of his products.

Where will Barford go from here? Some say it is out-moded, out-played, that the king-size mobile rally has had its day. Whatever the future, I like to remember tiny moments of Barford—the taste of icy Coke after the marathon of a Reception Desk for 2,000 people; the sound of the 3rd Air Force Band, the thwack of a baseball, the formal presentation of the magnificent glass plaque that we give to the Base as a token of gratitude, the hundreds of brilliantly clad people swarming over the sunlit field, the glitter of the cars massed in the parking lots, the clip-clop of the ponies, with their rumbustious passengers, Buffalo Bill and Robin Hood; the daffy spectacle of mobile whips bobbing in procession behind the hedges, as a stream of mobiles approach the Base; the year it rained; the year it blew; the year it touched 90°; the time the SSB station caught a VR6 and all the mobiles rushed back to their cars to try him. Most of all I remember the expression in the eyes of an American mother, whose tiny child had won a prize in a children's competition. She said "tom-ae-to" and I said "tom-ah-to." But we were one family. ■

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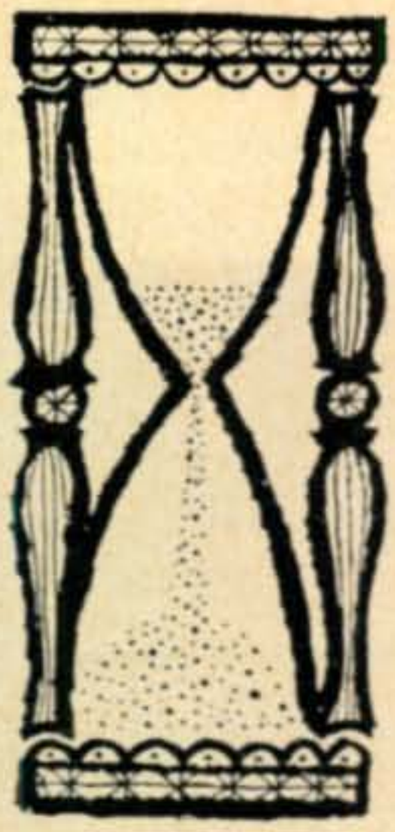


DO YOUR CONDENSERS STILL CONDENSE?

BY R. L. GUNTHER,* W6THN/VK7RG

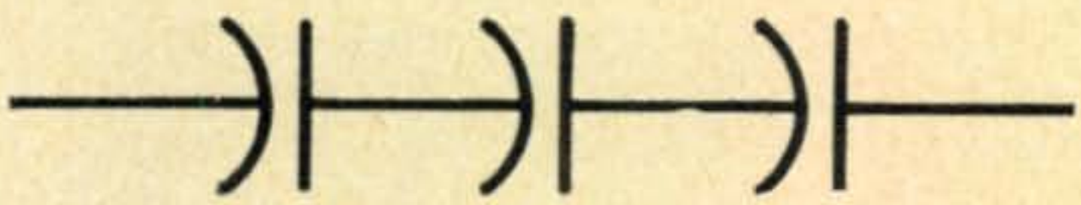
WHEN using 0.01mf paper condensers (which I shall reluctantly have to call 'capacitors') of good quality, to suppress transient overvoltages on 240 v. mains, I have twice had the unpleasant experience of having the capacitors blow up (literally!) even though they had a 600 w.v. rating. Since the capacitors are certainly desirable to protect silicon diode rectifiers[1], it is worthwhile to make sure that they have sufficient voltage rating. On the 115 v. a.c. lines this is not such a problem, but it still exists. A working voltage safety factor of 3 or 4 times over the nominal peak voltage of the a.c. lines is not excessive, since the capacitors have to be rated at least at the level of the transients they are trying to suppress. This got me started thinking about the whole matter of component reliability. It certainly seems that a 'good quality' capacitor will stand voltage overloads, better than a dud. What does this mean?

Capacitors

What about the junk capacitors which line my bulging parts box? Struck by this thought, I promptly took all said capacitors, and tested them on an a.c. (50/60 c.p.s.) bridge for capacity, power factor, and leakage (20 microamp limit for paper, 10 milliamps for electrolytics), at working voltage. The results were incredible. Ordinary paper capacitors which I should have trusted to act as grid blocking components showed excessive leakage, and you know that it doesn't take much current to drive a high impedance grid positive.

The power factor of many ordinary *paper* capacitors was terrible, not to mention that of electrolytics. In the middle of all of this, friend Rod, VK7ZAR, came in and pointed out that there is a lovely and obvious test for paper capacitors: put them on an ordinary ohmmeter having a center scale sensitivity of say, 1 meg. I did this, and the results were comparable. Some 0.01 mf and 0.1 mf capacitors showed d.c. resistances from 5 megs to 50 megs, and were, therefore, obviously unacceptable for just about anything; even in d.c. filtering applications there would be a real danger of their deteriorating further (owing to pinholes), causing disastrous shorts. (This happens regularly in certain surplus receivers!)

A good rule of thumb is to insist that a 1 mf paper capacitor measures at least 50 megs, with the resistance increasing as capacity decreases, and micas should measure over 100 megs[2]. A lot of my capacitors didn't measure up to this. And I threw all the bad ones out.



Electrolytics

Electrolytics, strange to say, fared somewhat better than paper capacitors; even units years old tested good for capacity, power factor and leakage, although the latter had to be evaluated after several minutes of reforming current[3]. If, after about 5 or 10 minutes of charging, the leakage current does not fall below 10 ma, it is probably too leaky at the rated voltage. At a lower voltage, it might be OK, though high leakage is a warning sign of incipient old age. I have hesitated to mention the necessity for reforming an old electrolytic, but I do because there are still people who will take a capacitor right off the shelf, plug it into a piece of equipment and wonder why a rectifier tube turns blue, or the capacitor gets hot. In a silicon diode type power supply running from a transformer, it will probably be the transformer which gets hot if the

*76 View Street, Hobart, Tasmania.

[1]Gunther, R. L. "Silicon Diodes and Common Sense," *CQ*, September 1965, p. 53.

[2]See the very interesting article 'Using the V.O.M. and the V.T.V.M.' by W. M. Scherer, *CQ*, May 1966, p. 27, in which this and other pregnant topics are discussed. He makes the statement, '50 Megohms per microfarad.' It should be '50 Megohm-microfarads' because microfarads go down as megohms go up, in proportion. This is to say, $C_1/C_2 = R_2/R_1$.

[3]To reform the dielectric of an electrolytic capacitor, simply connect the capacitor through protective series resistor (chosen for a few times the maximum charging current) to a potentiometer and voltage source. Increase the pot slowly so that measured current through the capacitor does not exceed say 10 ma. In a good capacitor, the current will continue to fall slowly at a given voltage, whence the voltage may be increased, but not above the w.v. Some jumping-about of the current meter needle is normal, particularly as the leakage current settles down. 10 ma is a reasonable maximum charging current for 10-100 mf, somewhat higher for larger capacities.

capacitor shorts, because modern diodes are pretty robust.

Now the trouble is that an electrolytic may test acceptably for leakage, etc., but simply won't filter d.c. properly; its dynamic impedance has gone up. About the only way to test for this curious disease is to apply pulsating d.c. to the capacitor from a half-wave diode and series resistor, and measure the a.c. component across the capacitor with a sensitive meter (or by suitable choice of components you can measure how much d.c. it develops). The better the capacitor is for filtering, the less a.c. you'll measure across it. For the most part, however, I just trust the leakage and capacity tests, applying this elegant method only in questionable cases.

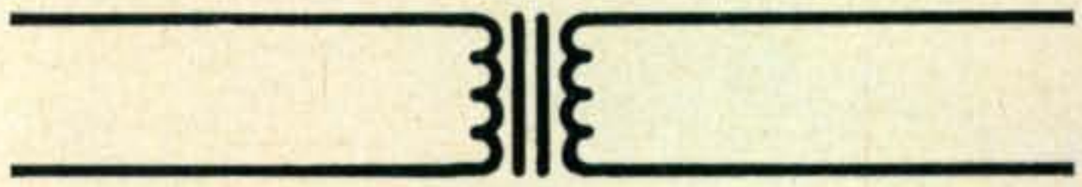
The ohmmeter test can be applied to electrolytics too[2], but I don't think it means much, because it will be reliable only if the capacitors are already well formed. If you go on the basis of the ohmmeter, you may throw out an electrolytic that could be reformed servicably. If, however, you do insist on using the ohmmeter (it *is* simple), be sure to get the polarity right; it is not usually obvious; it can be determined by measuring the resistance of a silicon diode; the cathode is the ohmmeters negative terminal when forwardly biased. When properly connected to an electrolytic, the meter should give a definite 'kick' toward lower resistance, and climb back up. If this kick is not observed for an electrolytic, it is probably open[2], and should be discarded. The actual value of final resistance which should be allowed is a matter for debate. VK7ZAR insists that I chuck them out at 1-2 megohms or less; they can make expensive fireworks if they fail in service. Scherer[2] quotes a value of 500K for high voltage, or 100K for low voltage capacitors. But unless I have reformed them, I tend to rate as acceptable anything above 50K for high voltage units, or 5K for low voltage ones. As I say, I don't think this test means much, but it is roughly useful, and can tell you when a capacitor is absolutely bad.

Resistors

The result of all this has been a great pile of capacitors in the waste basket, a saddened me, but an improved though thinner junk box. Then the thought occurred to me that this might not be limited only to capacitors. How about resistors and tubes. So I took some of those old old carbon resistors, the kind with pigtail leads wrapped around the ends, and put them into a v.t.v.m. grid circuit. Noise, drift, resistance values as much as 50% off the color coded values. These old resistors went out too.

Tubes

What is the use of having great stacks of unreliable (and space consuming) tubes? So into the tube tester went many of them (until I got tired of it; more next week—or thereafter). The results were equally depressing. Salvaged and bargain tubes were often weak, noisy, or showed low filament emission (G_m decreased appreciably when the heater voltage was reduced by 10%). What good are these? So into the 'salvage' pile they went. Salvage for what? Oh, bases for plugs, and perhaps some power supply usage where fine characteristics don't matter. But don't discard really big transmitting bottles if they test merely 'gassy.' They can often be degassed by prolonged application of heater, then reduced plate power.



Transformers

There isn't much to do about these. One transformer got hot only when the primary power was applied, with no load. There was a short somewhere, so off came the windings, with the core marked for possible other use.

I am afraid of the Mystique of Transformer Winding, but have found it convenient to wind a lot of heavy wire on an old core to make a high current choke or auto-transformer; even a little choking reduces greatly the amount of filter capacity necessary in a high current power supply for transistors, if you (as I) don't care about compactness.

Sometimes if I want some intermediate voltage like 50 volts, I ruin a perfectly good filament transformer by removing the secondary and rewinding a lot more turns of finer wire; usually it comes out about right. In this day of versatile relatively inexpensive transformers of various voltages, new or surplus, this kind of redesign is not as necessary as it once was, though it can be cheaper.

Then on to a 6 amp filament transformer which was manufactured by a famous name, but which got sizzling hot if more than 3 amps were drawn from it. I don't care if the varnish and enamel of modern gadgets are 'designed' for this kind of punishment; I still think it is obscene, and worsens voltage regulation. So, in big letters I wrote across this creature, '3 Amps Max.'

Rod Reynolds, VK7ZAR had some additional thoughts about transformers.

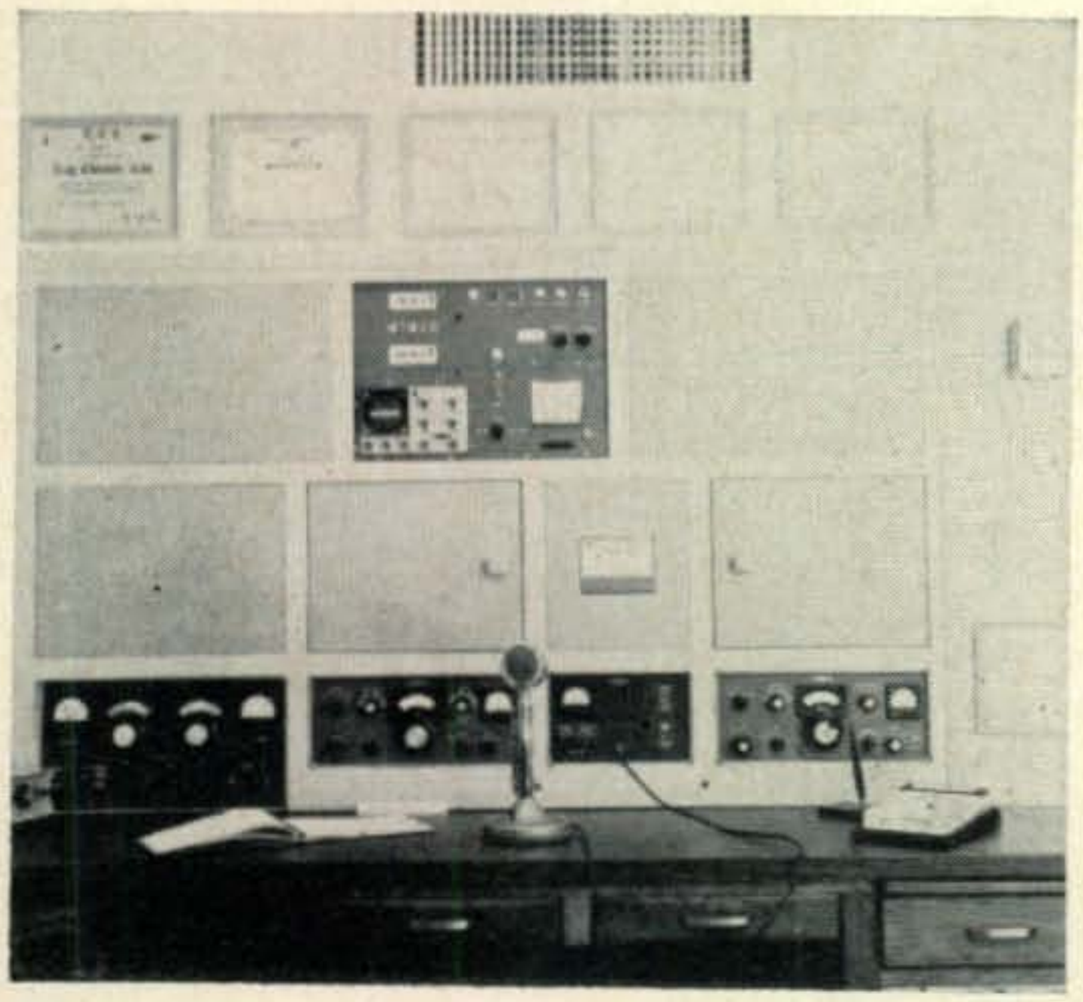
Rusty cores are good—the rust makes good interleaf resistance. The worse a transformer core looks, the better it is.

Don't use a burnt out transformer as a choke without first rewinding it; shorted turns can make a choke ineffectual. When rebuilding a transformer as a choke, rearrange the laminations so that an air gap of, say 1 mm (thick piece of cardboard) is inserted. This is to increase the flux path length, thus increasing the current rating, provided that the wire size is chosen to match. The actual amount of gap for optimum performance can vary considerably, so some experimentation would not be undesirable. The gap can be inserted into many kinds of cores by reassembling them, not by interleaving alternate E pieces,

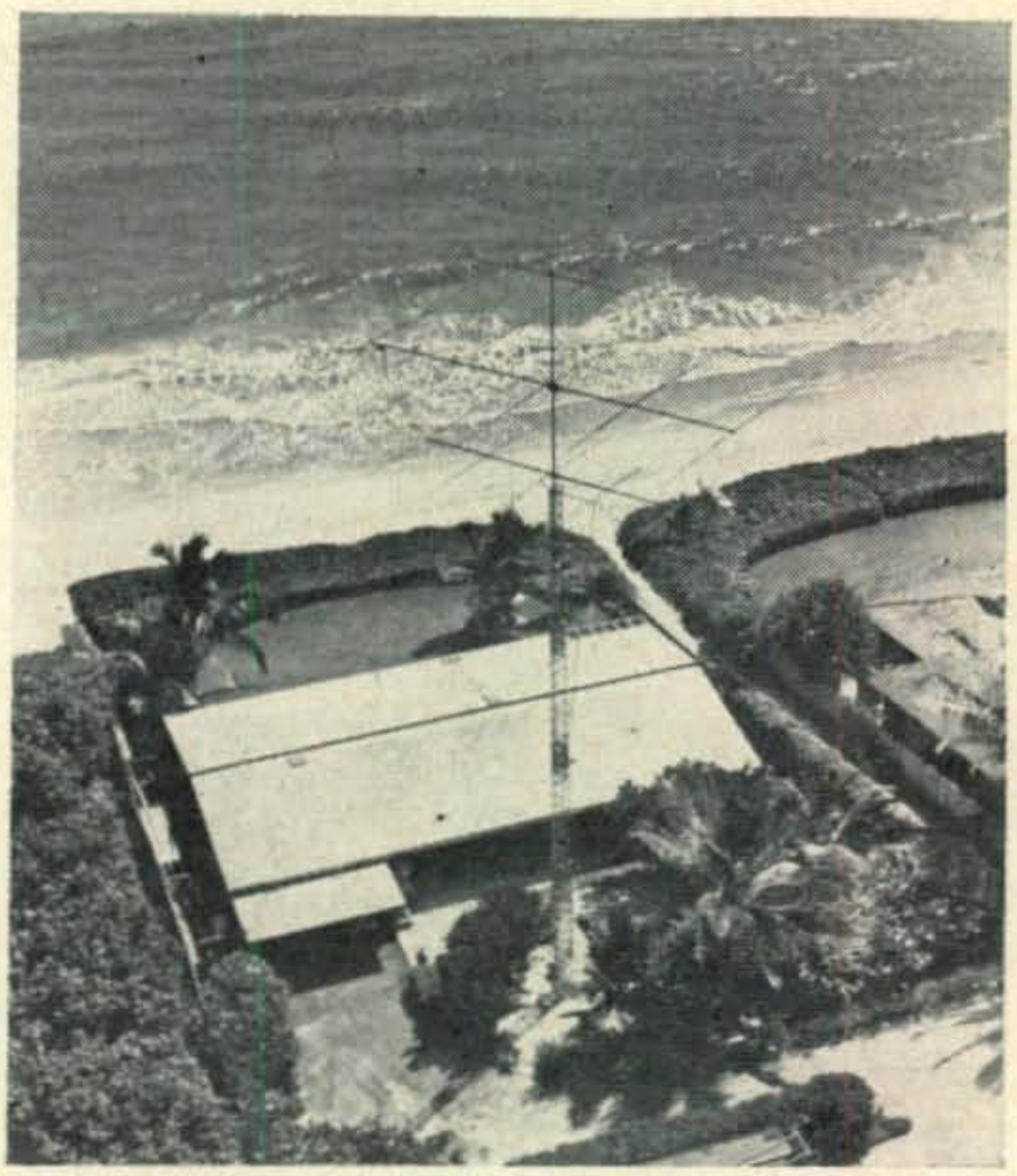
[*Continued on page 105*]

This past summer the Portuguese Radio League (R.E.P.) organized a First International Meeting of Radio Amateurs. The two day meeting was sponsored by R.E.P. and the tourist Depts. of Coimbra and Louzan (two cities 20 miles apart). The festivities started at Coimbra on a Saturday and continued the next day in Louzan. The photo on the left shows l. to r. CT1PN, the XYL of CTØ102, XYL of CT1LR, CT1LR, and CT1GA. The photo on the right shows to some extent the number of people who attended the function.

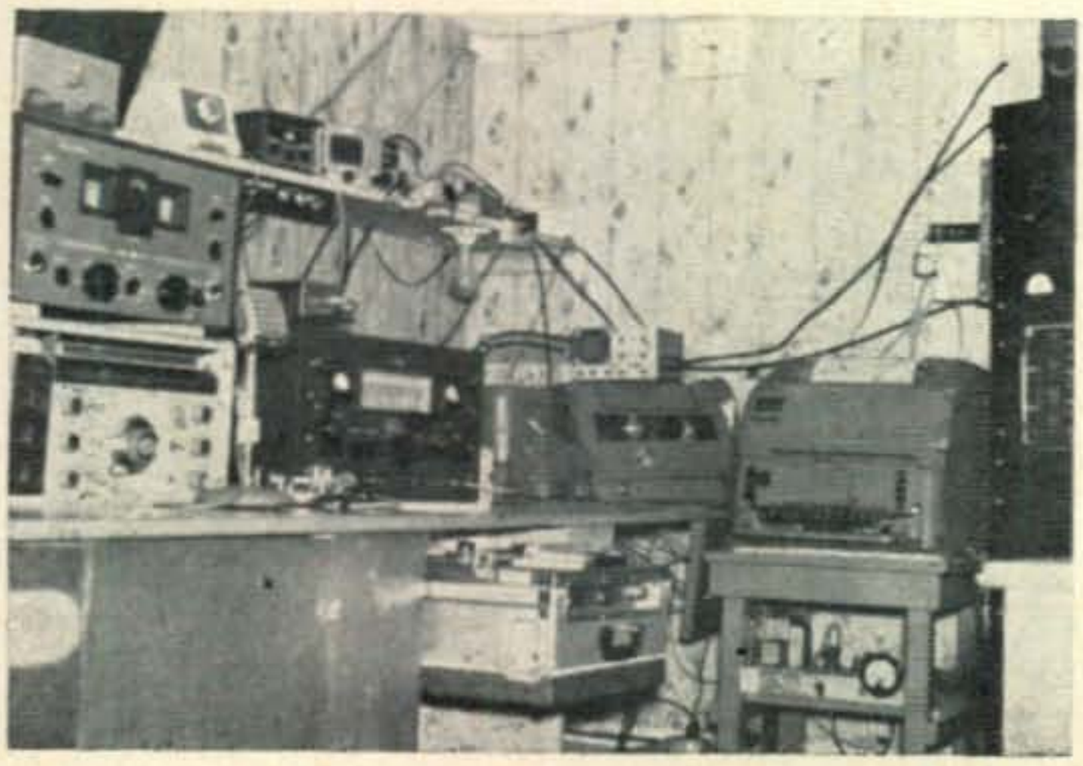
PEOPLE AND PLACES



After reading "Evolution of The Ham Shack" in the August issue, K7MJC went out and built a separate shack. The shack measures 18 × 14 feet and is completely air-conditioned. The equipment is flush mounted in the wall that separates the operating room from the work room.



Here's an ideal QTH that most hams dream about or plan for in the distant future. The place is the beach of Kailua, Hawaii and it is the QTH of Cameron Pierce, KH6EPW. To get an idea of height, the ten meter beam on top of the tower is 96' high. The antenna system is rated to withstand winds of 100 m.p.h.



This is the busy shack of VE3XF in Toronto, Canada. Len appears to be quite active on the air including RTTY with a Model #15 page printer and Model #14 typing reperforator and T.D.

The Knight-Kit TR-106 6-Meter Transceiver shown with the V-107 6 and 2 meter V.F.O. The dials for both units are calibrated in 100 kc steps spaced about 3/16" apart. Rocker-type switches are used except for the crystal/v.f.o. selector. A slide switch for a N.L. on-off is located on the rear apron.

CQ Reviews:

The Knight-Kit TR-106 6-Meter Transceiver and V-107 V.F.O.

BY WILFRED M. SCHERER,* W2AEF

A RECENT kit added to the Knight-Kit line of amateur gear is the Model TR-106 6-Meter Transceiver. It incorporates a tunable double-conversion receiver and a 15 watt plate modulated transmitter with three crystal control positions. There also is a v.f.o. position with which an accessory v.f.o., the Model V-107, may be used. A built-in power supply operates from either 120 v.a.c. or 12 v.d.c. merely by attaching the appropriate plug and cable, facilitating either fixed or mobile installation. A 2 meter version of the transceiver, the Model TR-108, also is available.

Other features include: frequency range—50-52 mc, crystal-controlled front-end converter using a Nuvistor, self-adjusting a.n.l. with on-off switch, headphone jack, built-in loudspeaker, illuminated dial, illuminated meter automatically switched to read receiver S-units or transmitter relative-power output, transmitter-on light, adjustable pi-net output for 30-90 ohm loads, p.t.t. operation, crystal/v.f.o. spotting switch, high modulation with peak limiting, r.f., a.f. and mic gain controls, modern styling and rugged construction.

Receiver Section

Referring to fig. 1, the receiver section makes use of a 50 mc crystal controlled converter and a tunable 15.6-17.6 mc i.f. strip with a 2nd i.f. of 1650 kc. High primary and secondary image rejection is thereby obtained along with adequate selectivity for the job at hand.

A departure from the usual in 6 meter receivers is that the converter is installed as an individual self-contained unit and is designed for performance like that obtained with high-grade converters often used separately with a communications receiver.

High sensitivity and low noise are ensured through the use of a 6DS4 Nuvistor in the converter r.f. stage which is neutralized using the capacitance bridge method. See fig. 2. The pentode in a 6EA8 is the mixer, while the triode section functions as the h.f. oscillator using a 34.4 mc 3rd overtone crystal with conventional circuitry. Oscillator signal injection to the mixer is obtained through the inter-electrode capacitances of the tube.

The input of the r.f. stage is peaked at 50.5 mc and the output at 51.5 mc, while the mixer output is appropriately peaked in the 16 mc range so that the overall result of the stagger tuning is a relatively flat bandpass for 50-52 mc coverage. The input impedance is 50 ohms.

The converter is a completely shielded unit and has feedthrough type bypasses for all power leads. In addition, the output from the tuned circuit of the mixer is obtained by means of a low impedance link that is coupled with shielded cable to a low-impedance primary at the input of the variable i.f. stage. R.f. isolation is maintained and stray r.f. pickup, noise and spurious signal responses are minimized.

The 15.6-17.6 mc variable i.f. simply consists of a mixer using the pentode in a 6EA8. The triode section of the 6EA8 is a temperature compensated Hartley oscillator that tunes from 13.95 to 15.95 mc to provide a fixed i.f. output of 1650 kc. The mixer input is gang-tuned along with the oscillator to maintain peak performance over the range. Two stages, with double-tuned coupling transformers, are used for the 1650 kc i.f. A.g.c., obtained from the diode envelope detector, is applied to both i.f. stages. The a.n.l. is the self-adjusting series type.

Transmitter Section

The transmitter portion of the set begins with a 12DK6 pentode using fundamental type 8.3 mc crystals in a Colpitts circuit where the screen

*Technical Director, *CQ*.

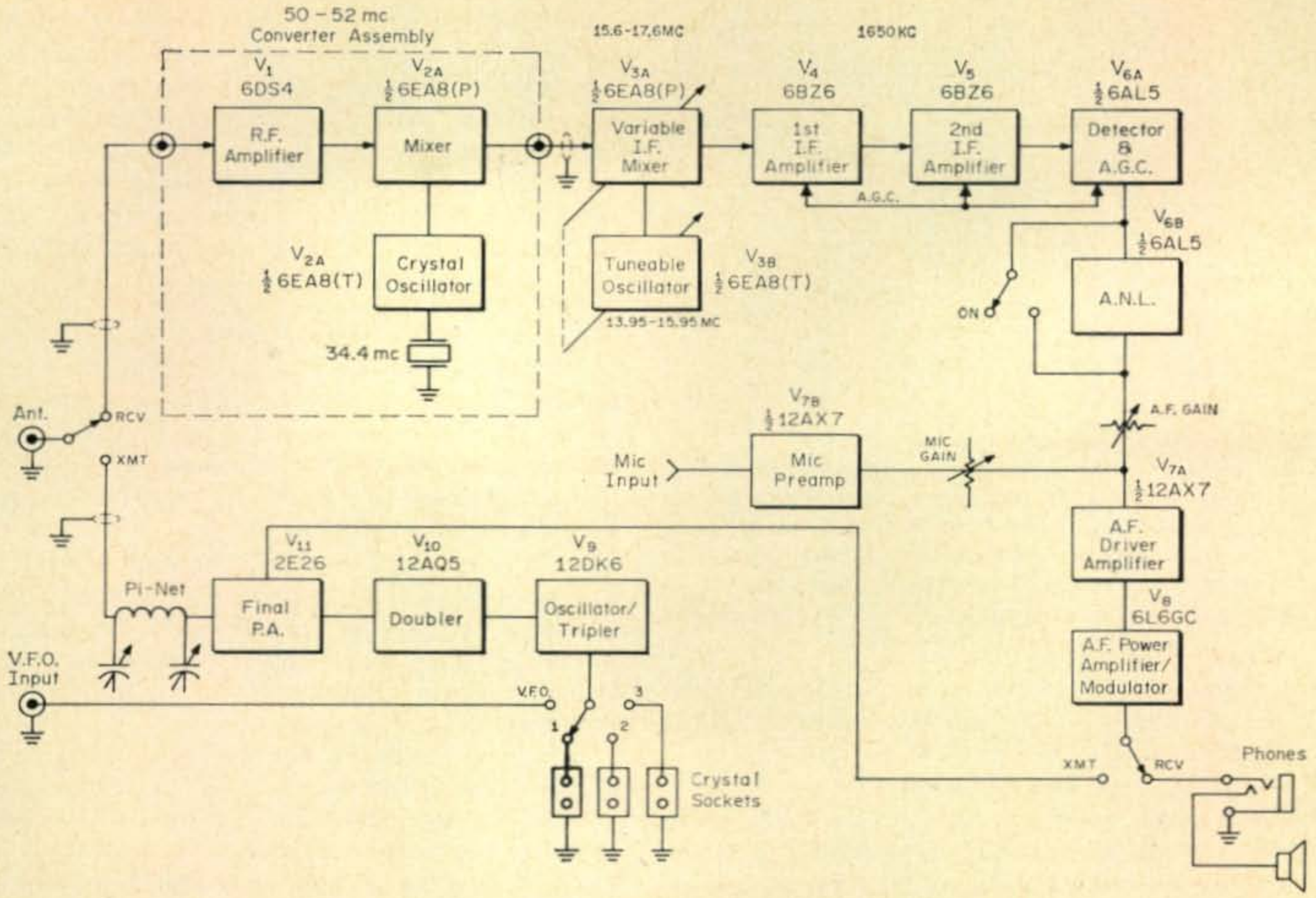
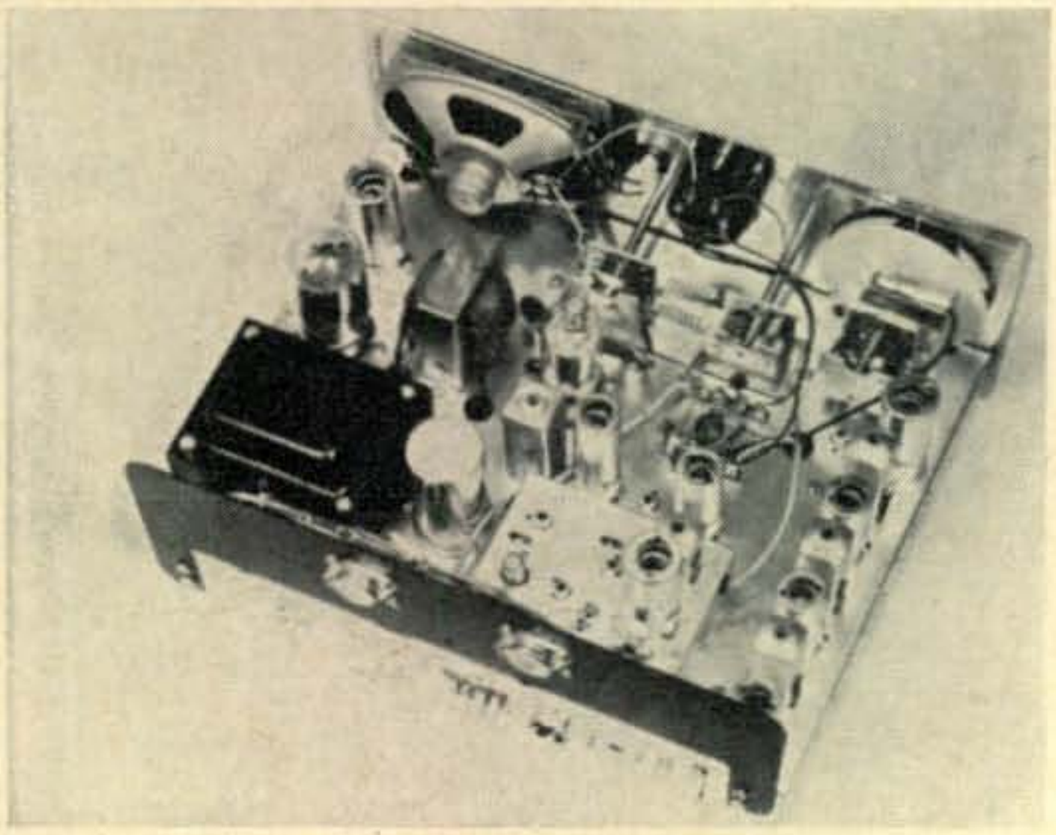


Fig. 1—Block diagram for the TR-106 transceiver. Power switching setup is not indicated.

of the tube serves as a triode plate. Frequency tripling to 25 mc is obtained with a tuned circuit at the pentode plate which is electron-coupled to the oscillator. A 12AQ5 is then used to double to 50 mc and to provide plenty of r.f. drive for a 2E26 straight-through final amplifier that utilizes an adjustable pi-net output circuit. Bias for the final is obtained from a grid leak and a "protective" self-bias cathode resistor. The 12AQ5 is inductively coupled to the 2E26 through a double-tuned circuit, providing sufficient bandpass without retuning and ensuring a measure of harmonic minimization. Neutralization of the final is not required.



Top-chassis view of the TR-106. The preassembled converter is shown in the foreground. The p.a. output circuit components are at the upper center. The receiver-tuning capacitor is at the upper right corner. Switching transistors for 12 v.d.c. operation are on the rear panel of the set (shown in foreground).

A four position switch allows the selection of any one of three crystals, for which there are plug-in sockets on the panel, or v.f.o. control for which there is a jack on the rear apron.

The a.f. power output stage of the receiver also serves as the modulator for the transmitter. This stage uses a 6L6GC which can provide more than enough a.f. power; however, the operating voltages and the transformer design have been set so that clipping takes place just before 100 per cent modulation.

A speech amplifier is used ahead of the a.f. driver, a 12AX7. Both a mic gain and the receiver a.f. gain controls are in the driver grid circuit, but interaction between the two is avoided using the scheme shown at fig. 3. A feature, particularly beneficial with v.h.f. gear, is that the cathode resistors of all the a.f. stages and the final p.a. are bypassed separately both for a.f. and r.f. to minimize the chances of r.f. feedback.

High frequency roll-off above 3000 c.p.s. is obtained with suitable shunt capacitors at the grids of the speech and a.f. power amplifiers. Switching between transmit and receive is handled by means of a relay operated by a p.t.t. button on the mic, but another switch also is provided on the panel. This is very handy for tuneup. During switching, a high voltage surge capacitor, connected across the primary of the a.f. output transformer, protects it against damage by voltage transients that might occur at the time.

The S meter functions in a bridge circuit connected in the B plus feed to the a.g.c. controlled 2nd i.f. During transmit, the B plus is removed and a diode automatically rectifies the r.f. out-

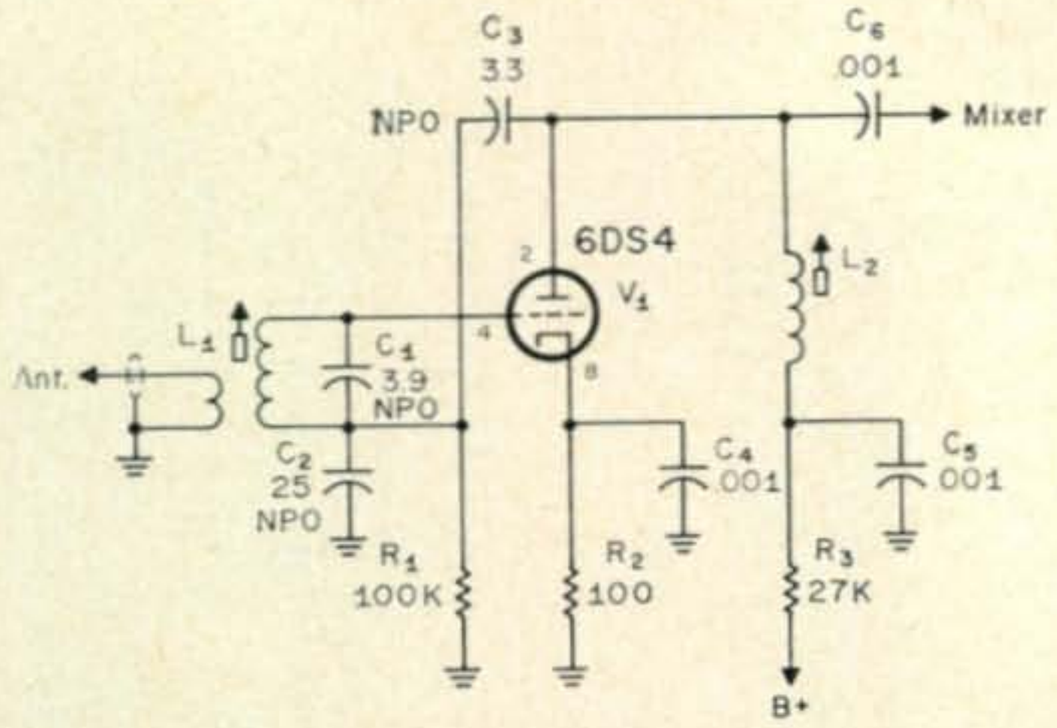


Fig. 2—Neutralization of the r.f. stage in the v.h.f. converter for the TR-106 is accomplished with the capacitance-bridge scheme as commonly used in a single-ended p.a. for transmitters. Circuit stability is obtained by properly proportioning the ratio C_3/C_2 with that of the grid-plate and grid-circuit-cathode capacitances at the tube.

put to actuate the meter for indicating the relative-output power. No manual meter switching is needed.

Power Supply

The power supply utilizes silicon diode rectifiers in a voltage-doubling setup with R/C filtering. The power transformer has two primaries, one for 120 v.a.c. operation, the other for 12 v.d.c. operation with power-type switching transistors employed in place of a vibrator as used before the advent of transistors. The switching rate is about 90 c.p.s. Separate fuses are provided for a.c. and d.c. operation and individual power cables with appropriately jumpered plugs are used for each type of primary power.

Assembly

The TR-106 went together quite easily. First of all, the v.h.f. converter is supplied already assembled and aligned. All you have to do is mount it on the chassis at the designated time and connect its power leads and shielded input and output cables. The rest of the work is conducted following step-by-step instructions that are given on the left pages of the manual in which the opposite pages on the right illustrate each associated step. Parts such as resistors and small capacitors are furnished on cards with each component individually identified by number. On the other hand, the neophyte might have difficulty in recognizing other components, because an illustrated hardware and parts identification sheet was not supplied with the kit.

An interesting twist in kit assembly instructions is that at many points it is suggested that the builder rest a while before continuing the work; good advice that should reduce fatigue and thus minimize the possibility of errors. Working at an easy pace, 25 hours of time were involved in assembling the transceiver.

Alignment

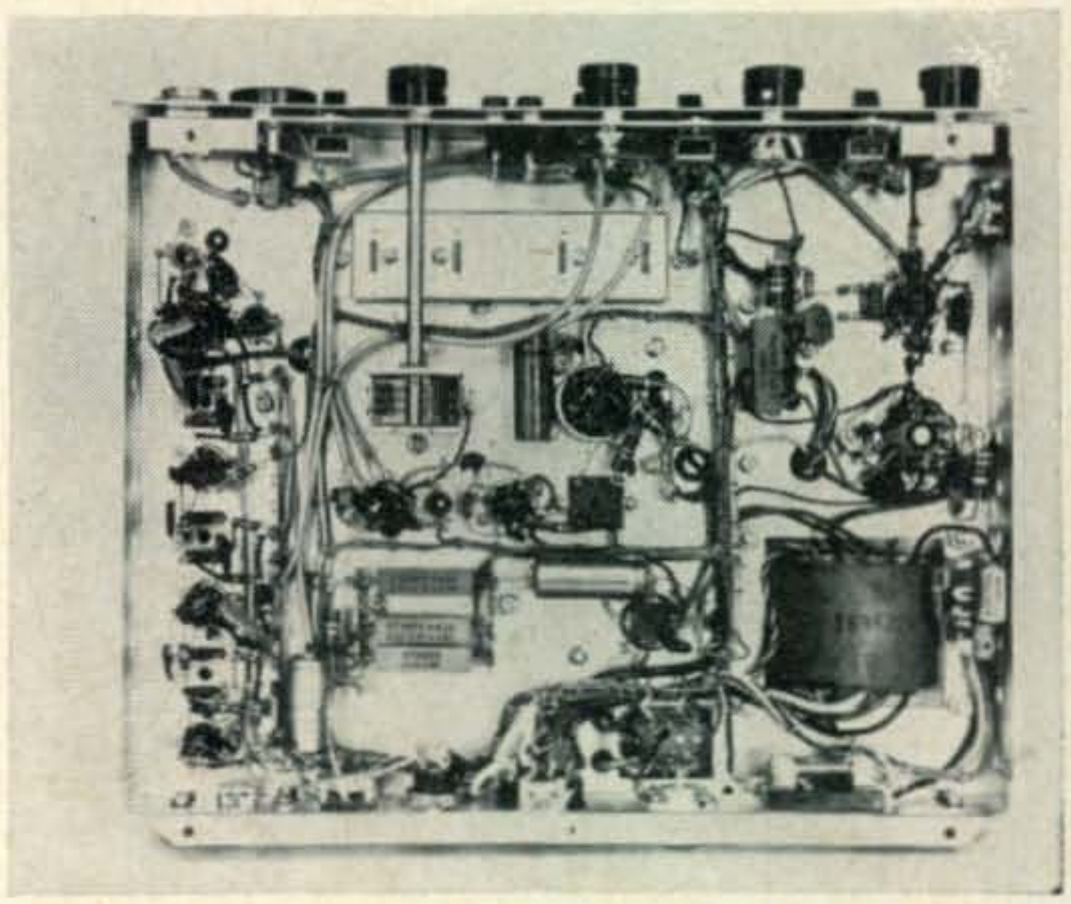
No adjustment of the converter is needed. The rest of the receiver may be aligned using a signal generator or with 8.3 mc crystals in conjunction with the crystal-spotting position. A v.t.v.m. is recommended for an accurate indicator, but the S-meter or background noise may be used as a substitute. The most stringent part of the tune-up is setting the calibration of the tuning dial. This requires one signal near the bottom of the band, another near the top, for which the builder most likely will have appropriate crystals. Transmitter adjustment is conducted in normal tune up fashion using the transmitter crystals.

Performance

With a 50 ohm source, the noise figure of the receiver was better than that of many converters we've checked out, measuring at 3.4 db. Taking into account the overall response of the setup, this would result in a sensitivity close to the specification of 0.5 μv for 10 db S/N ratio. The i.f. selectivity at the 6 db points amounted to 10 kc (rated at 8 kc). Signal rejection at the 1st i.f. (16 mc) and at the 2nd i.f. (1650 kc) was up to the ratings of 50 and 70 db respectively, while image rejection came within the rating of 55 db or better.

Frequency stability for the receiver was 15 kc drift during the first 20 minutes from a cold start at 70° ambient, 2 kc the next 30 minutes and 1 kc per hour thereafter. This is well within the requirements for a.m. reception in relation to the i.f. bandwidth and eliminates the need for chasing a signal around as is so often experienced with some transceivers.

With 120 v.a.c. or 13.6 v.d.c. power applied, the transmitter carrier input was 14 watts, the r.f. output 6.75 watts. Modulation was possible up to just under 100% where both the negative and positive peaks squared off. No negative-peak overmodulation nor carrier breakup was observed. Good waveform was found below the clipping point. In this regard, high mic gain can result in excessive clipping and distortion, so during operation it will be best to adjust the mic gain to where the relative-output meter kicks only slightly. It was gratifying to find that this rig "fully" modulates, inasmuch as many 6 meter signals we've heard produce little effective voice power due to insufficient modulation.



Under-chassis view of the TR-106. A neat wiring job can be made which is facilitated by a wiring harness furnished with the kit.

Although protective cathode bias is used on the final p.a., loss of excitation should not be tolerated very long, since the plate dissipation of the 2E26 (without r.f. drive) was found to rise somewhat above the tube rating.

As may be seen from the photographs, the TR-106 is nicely styled in a wrap-around case. Its size is 5½" × 13⅛" × 11" (H.W.D.).

V-107 V.F.O.

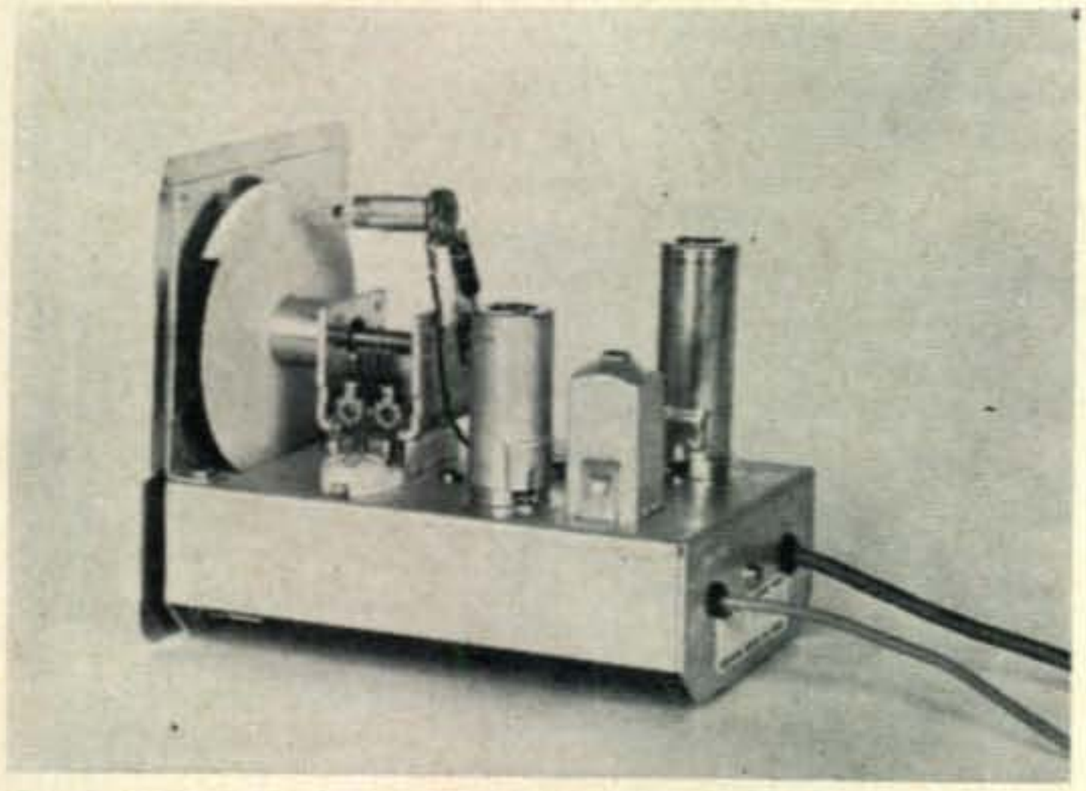
The Model V-107 Accessory v.f.o. is designed for use with either 6 or 2 meter gear. On 6 meters it takes care of only the lower portion of the band from 50 to 52 mc. Full band coverage is obtained with 2 meters.

A 12DK6 pentode functions as an electron-coupled oscillator in the familiar series-tuned Colpitts or Clapp circuit using the screen grid for a triode oscillator plate, while output is obtained from the pentode plate which is tuned to the oscillator frequency.

The actual frequency range of the v.f.o is 8.333-8.666 mc, which when multiplied in the transmitter, provides the 6 meter coverage. For 2 meter use the v.f.o. has to be aligned to operate on 8.0-8.222 mc. Temperature compensation, double-spaced tuning capacitor, voltage regulator, rugged components and careful structural design provide excellent thermal, mechanical and electrical characteristics that result in good frequency stability. Special attention also has been paid to operating voltages that will result in as harmonic-free an output as possible for minimizing spurious signals that could cause TVI. Frequency multiplication is left up to the transmitter itself.

Power for the v.f.o. is obtained from an external source, such as the TR-106 Transceiver. For use with other gear, the power requirements are: 12.6 v. a.c. or d.c. @ 150 ma and 200 v.d.c. @ 30 ma. The r.f. output potential is rated at 20 v. r.m.s. minimum into 47,000 ohms shunted by 30 mmf. The unit has its own STANDBY-OPERATE switch, but it also may be controlled by the transmitter switching facilities.

The v.f.o. has a vernier driven dial (6:1 ratio) that is back lighted and which has two calibrated scales, one for 6 meters around one half of the perimeter, the other for 2 meters along the second half. The dial is positioned on the shaft of the tuning capacitor according to the band for which the v.f.o. has been set up. In this respect, operation without realignment is possible on only one range at a time, thus making the job a one band affair according to the user's choice.



Chassis view of the Knight-Kit V-107 6 and 2 meter v.f.o. The taller tube shield surrounds the voltage-regulator tube.

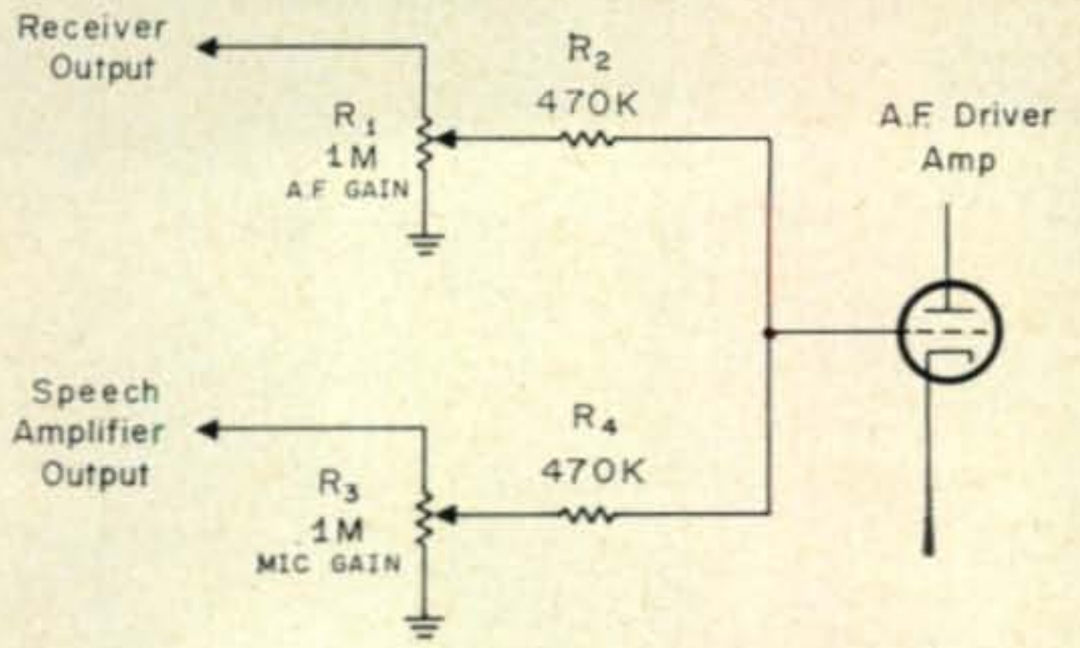


Fig. 3—Circuitry used in the TR-106 for connecting both the A.F. and MIC GAIN controls across the amplifier-tube grid without causing interaction between the controls. It is seldom seen in amateur gear, but is quite common in audio equipment. R_2 and R_4 prevent resistive loading or a short-circuit at the output of one control by the other control when the latter is near or at minimum setting.

The v.f.o. may be aligned and calibrated by zero-beating against transmitter crystals in the spotting position of the receiver or by listening on a receiver that tunes the 8-8.66 mc range. With the former method, it was found that there were several points where the zero-beat could be obtained. Incorrect adjustment is indicated when tracking with proper calibration cannot be achieved over the v.f.o. scale or if the transmitter does not function with the v.f.o. after tuneup has been made using crystals. In either case, it will be necessary to start over again, readjusting the coil slug to a new point where a beat with the crystals can be obtained.

The frequency stability of the v.f.o. was; 3 kc drift during the first 30 minutes of operation from a cold start at normal ambient, another 4 kc the next 30 minutes and then 1 kc or less per hour. Hard banging of the v.f.o. case did exhibit slight frequency vibration and shaking the unit introduced some frequency shimmy; however, such conditions are not likely to occur with fixed operation, nor would these effects be detrimental to a.m. work. Line-voltage variations of ± 10% produced only a ± 200 c.p.s. change which shifted slowly as the tube heater temperature drifted. Unlike some 6 meter v.f.o.'s and even with crystals, the frequency does not shift or creep at the start of each transmission.

A tendency toward r.f. feedback was evidenced by a slight ripple of the v.f.o. output, unless its output coil is tuned to a critical point. We therefore suggest that when this circuit is finally tuned, you listen on a receiver with a b.f.o. for the attainment of the setting on L_2 that results in a T9 signal when the output is near maximum.

[*Continued on page 100*]

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THE BUTTERWORTH FILTER COOKBOOK

BY DONALD LANCASTER*

Part I

Below are some recipes for painless filter design based on Butterworth polynomials. By choosing the basic circuit and following the directions for multiplying and dividing, most low pass, high pass and band pass filter problems can be solved rather easily.

THE designing of filters for any electronic circuit always seems to involve a bit of deep mystery and perhaps require a hand or two dabbling in the black arts. A powerful new class of filter circuits with remarkable properties is easily designed and applicable to the majority of electronic filter problems. By choosing one of the basic circuits given here, followed by a simple division and multiplication, the majority of low pass, band pass, and high pass filters can be immediately solved. And the results are in actual component values, ready for immediate breadboarding and circuit verification. Further, the results are always in good agreement with the original design and are exactly predictable.

These filters are called *Maximally Flat Amplitude* or *Butterworth* filters. Maximally flat simply means that as much of the filter's passband is made as flat as possible. Since the math behind these filters uses *Butterworth Polynomials*, the name is carried over.

There is no such things as a perfect filter. Even one with an infinite number of perfect inductors and capacitors would have a significant drawback: It would take infinitely long for a signal to pass from one end of the filter to another! Thus, any filter, however good, must result in some compromise. It will be ideally suited for some applications and misapplied in others. Here's how the Butterworth filter performs:

Advantages

1. The passband of the filter is always defined to points at which the response is precisely 3 decibels attenuated. This is the *cutoff frequency* or frequencies of the filter.

*4229 North 23rd Avenue, Phoenix, Arizona 85015.

2. The passband is very smooth and flat with no lumps, ripple, or overshoot.
3. The further one ventures into the stopbands, the higher the attenuation becomes.
4. The attenuation at *any* frequency is accurately predictable from a simple curve.
5. Lossy (finite "Q" and "D") components do not drastically affect performance, but show up mainly as insertion loss and changes in skirt steepness.

Disadvantages

1. For extremely steep skirts, other forms of filters (Tschebyscheff) will do the same job with fewer parts.
2. There are no points of infinite rejection near the cutoff frequency as might be required if a signal near the passband must be sharply rejected. Thus Butterworth filters are not well suited to single sideband filters and similar applications.

Low Pass Filter Types

Let's see how a Butterworth filter's amplitude response will compare with an ideal filter, as in fig. 1. An ideal low pass filter passes all frequencies from d.c. to a specified cutoff frequency without any loss or attenuation. Beyond cutoff, all signals are infinitely rejected. The Butterworth response will be uniform over most of the passband, but will be attenuated exactly 3 decibels (0.707 voltage or 0.500 power) at the cutoff frequency. The response then continues to decrease as frequency increases.

The Butterworth low pass filter takes the form of a *ladder* network consist of *series* inductors and *shunt* capacitors. At high frequencies, each shunt capacitor provides a very low reactance to ground and each series inductor presents a very

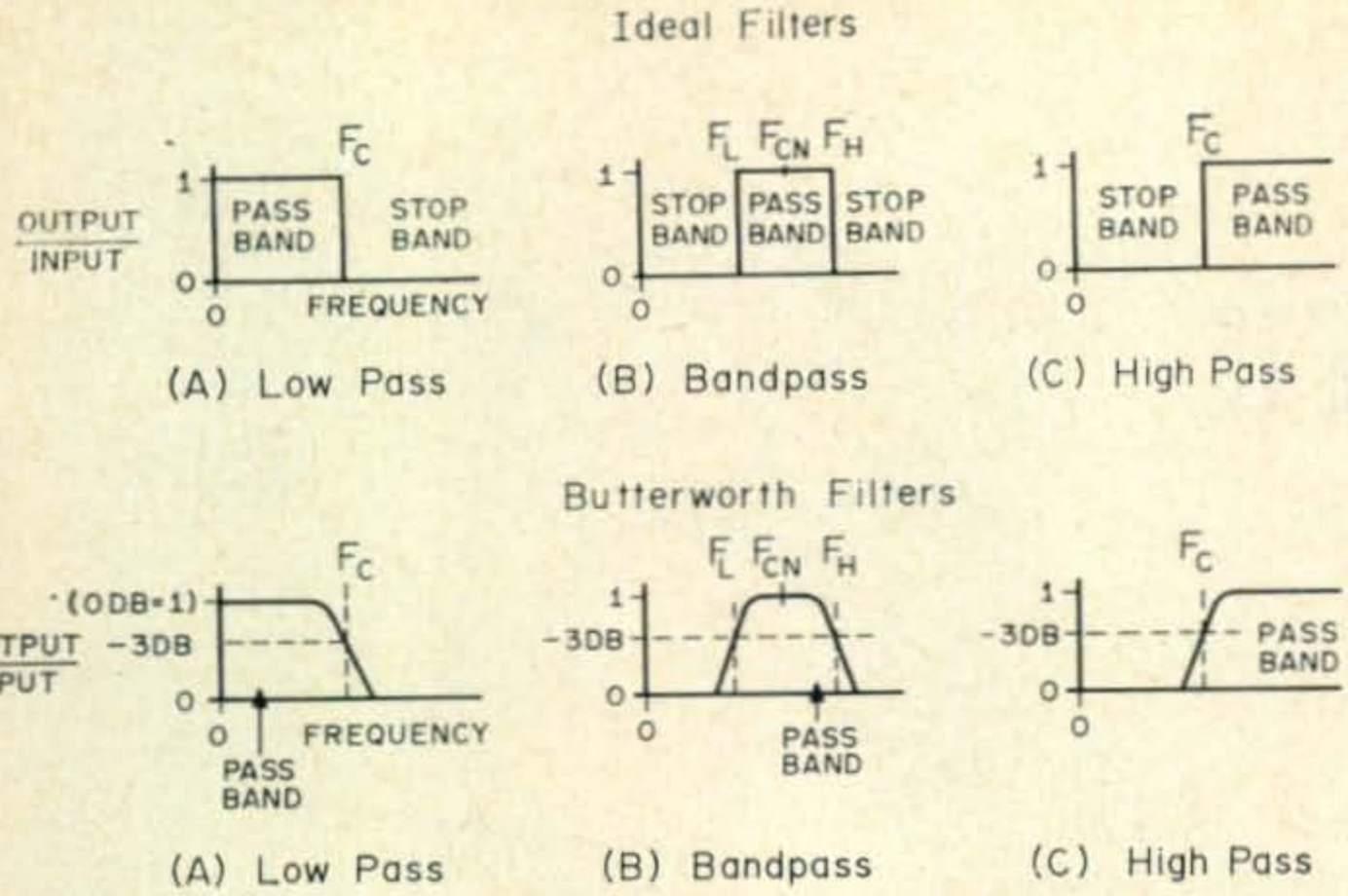

Fig. 1—Comparison between the responses of the ideal filter and Butterworth filters. The cutoff frequency of the Butterworth filter is at the —3 db point which is 0.707 of the maximum voltage or 0.5 of the maximum power (the half power point).

F_l = Low f. F_c = Cutoff f. F_{cn} = Center f. F_h = High f.

high reactance between input and output, highly attenuating any input signals. At low frequencies, the opposite is true, allowing an input signal to reach the output with no attenuation.

We might rightly suppose that as the number of inductors and capacitors (each is called an *element*) is increased, the skirt would become steeper and the passband response would become flatter. This is plotted in fig. 2 which shows the improving filter response as the number of elements are increased. At high frequencies, the attenuation improves at the rat ef —6n decibels/ octave. As an example, a five element filter (three inductors; two capacitors) gives a *rolloff* of —30 decibels per octave well above cutoff. Going up one octave *doubles* frequency. A —30 db/octave slope means that only 1/1000 the power at some frequency will be passed for a signal of double that frequency. It can be seen that this is a powerful filter technique.

Note that the cutoff frequency is *always* 3 db down and at the same frequency, regardless of the number of elements.

The High Pass Filter

A *high pass* filter is nothing but an "insided out" low pass filter. The ideal filter passes all frequencies above a cutoff frequency and infinitely rejects all those below. (See fig. 1 (B).) The Butterworth filters are, again, flat over most of the pass band and down 3 decibels at cutoff. This time, the filter consists of *series* capacitors and *shunt* inductors. At high frequencies, the signal sees a low impedance path between source and load. At low frequencies the input signal sees a very low impedance to ground and a very high one to the load, providing the required attenuation improves at the rate of —6n decibels/ wards and are shown in fig. 3. Outside of the fact that they are opposites, the performance of low pass and high pass filters are quite similar, requiring the same number of elements to do a similar job.

The Band Pass Filter

A *band pass* filter only passes a certain range of frequencies, called the *bandwidth*. Again, the ideal filter is "square", while the Butterworth is down 3 decibels at the cutoff frequencies. (See fig. 1 (C).) The bandwidth is the difference between the upper and lower cutoff frequencies or

$$\Delta F = F_h - F_l$$

where F_h is the upper cutoff frequency and F_1 is the lower. The *center frequency* of the passband is the *geometrical* mean of the cutoff frequencies, or

$$F_{cn} = \sqrt{F_h F_l}$$

where F_{cn} is the center frequency. Note that this is *not* the "average" of F_h and F_1.

Figure 4 shows how bandpass circuits take the form of resonant *LC pairs* that form a ladder network. The *shunt* pairs parallel resonate; the *series* pairs series resonate. In the passband, a low impedance path is formed from input to output providing signal transmission since the series resonant pairs are *low* impedances and the shunt pairs are *high* impedances. Well above the passband, the filter rejects just as a low pass one does. Well below the passband, the filter behaves just as a high pass filter.

Each *LC* pair is called a *section*. The skirt steepness is not defined as so many decibels/ octave of center frequency, but *as so many decibels/octave of the bandwidth*. The skirt steepness for a given number of sections will be identical as the skirt steepness of a low pass filter equal to the bandwidth having as many elements as the bandpass filter has sections.

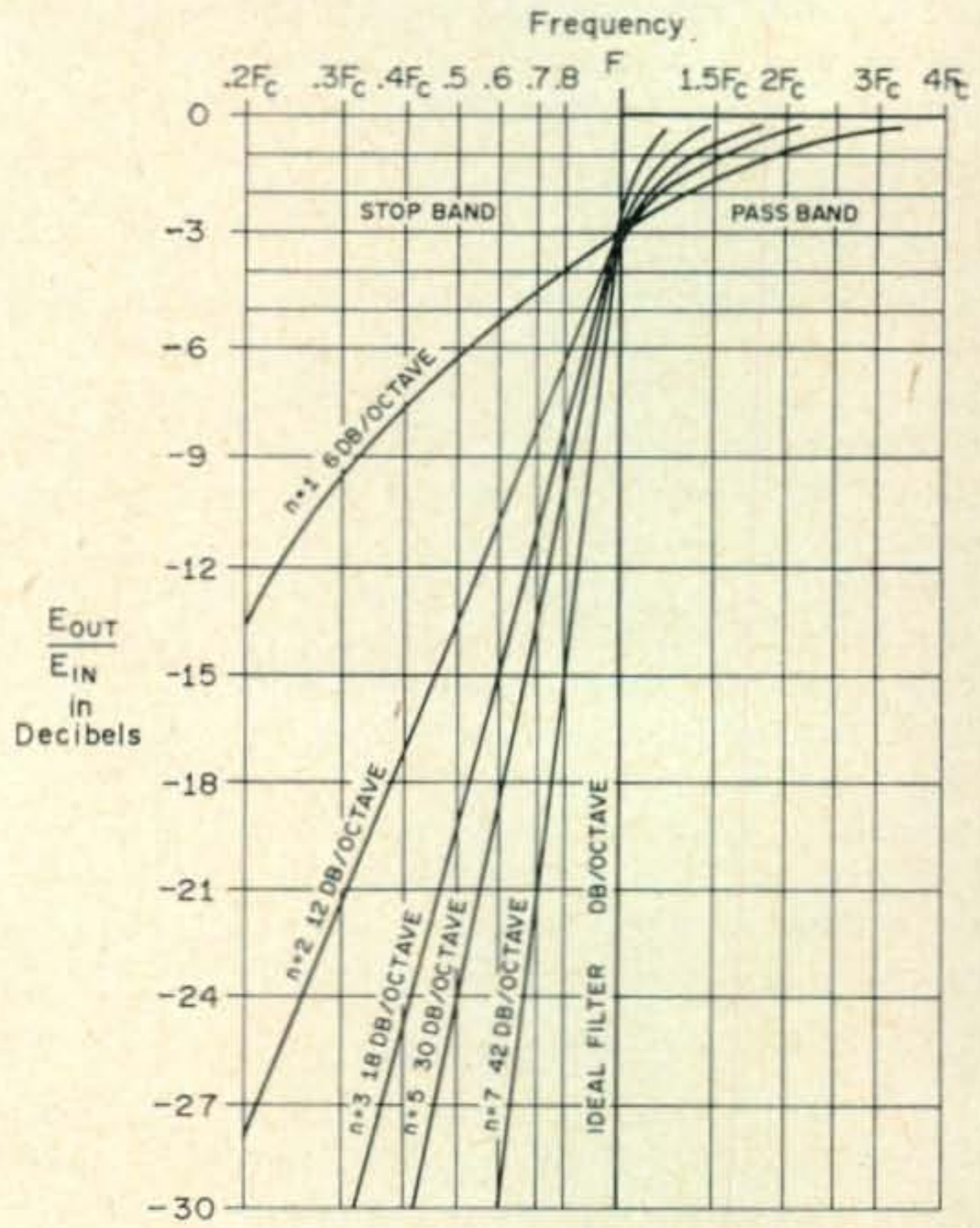

Fig. 2—Frequency response of Butterworth low pass filters. F_c is the cutoff frequency and n indicates the number of filter elements.

Thus fig. 2 gives the skirt steepness of a bandpass filter in terms of so many decibels/octave of the bandwidth. The n required will equal the number of *sections* (half the number of elements) to allow the bandpass filter to meet a certain skirt requirement. The skirt on the low side will be the geometric mirror image of the high side skirt. Two frequencies X and Y will have identical attenuation if $XY = F^2_{cn}$.

Normalization

Normalization is one of those strange filter terms but its meaning is quite simple. The only difference between a 1 kilocycle filter and a 10 kilocycle filter is that all the inductors and capacitors are ten times as large on the 1 kc model. Similarly, the only difference between a 50 ohm filter and a 100 ohm one is a factor of two on all the parts values.

As we raise frequency, we lower the values of L and C required, but the resistance values are not affected. To raise the impedance level of a circuit, we must increase all resistance and reactance. To increase reactance, we must increase all inductors and decrease all capacitors, since a capacitors reactance decreases with increasing capacity.

Since only constants are invloved in moving around in frequency or impedance level, we only need consider circuits working into an *one ohm load* with a *one cycle per second* cut off frequency. This is called a basic, or *normalized* filter. To scale frequency, we divide all L and C by the new frequency. To scale impedance, we multiply all R and L and divide all C by the new impedance level.

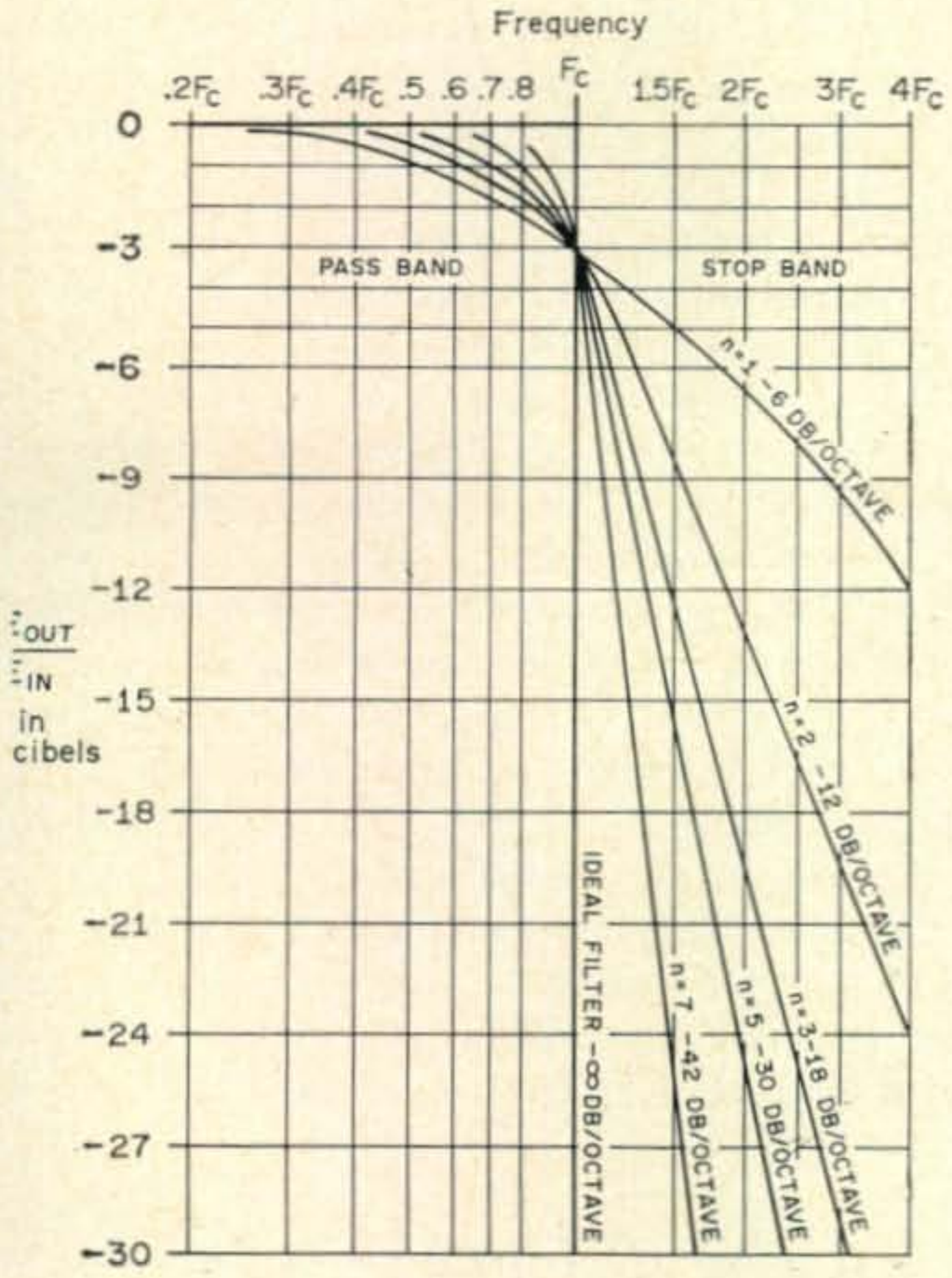

Fig. 3—Frequency response of Butterworth high pass filters. F_c is the cutoff frequency and n indicates the number of filter elements. Note that these curves are simply a reversal of the low pass curves shown in fig. 2.

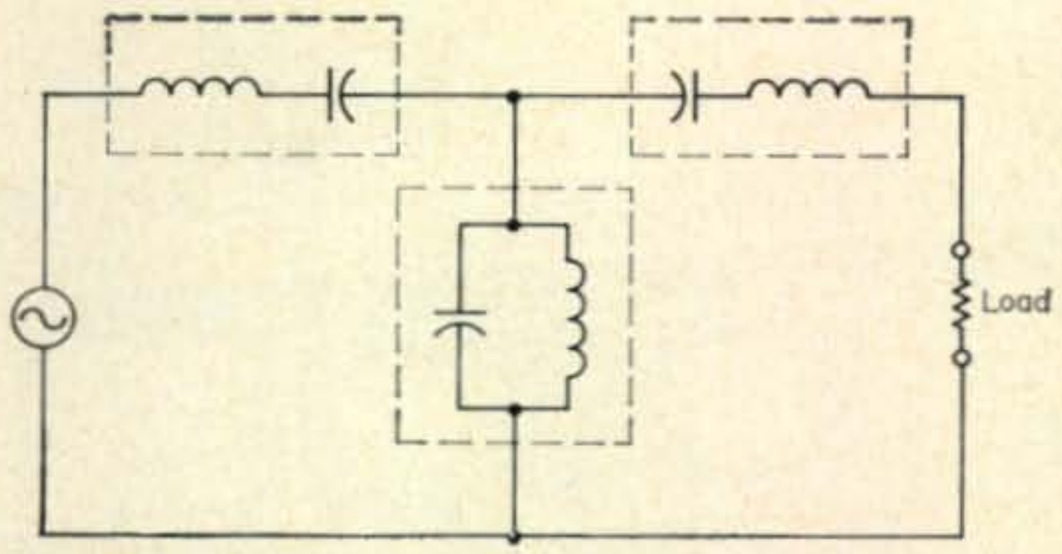

Fig. 4—Basic band pass circuit makes use of series and parallel resonant pairs. Each LC pair is called a section.

One distressing sidelight of this normalization is that the component values will initially show up in henrys and *farads*. These somewhat ridiculous capacitance values become entirely reasonable as impedance and frequency are scaled.

Impedance Matching

We are here presenting only two types of basic filters. One type operates only between a "stiff" voltage source and a load. Typical of such sources are the a.c. power line, emitter and cathode followers, and the outputs of audio amplifiers with high feedback and damping.

The second filter type operates between an impedance matched source and load. Some typical situations are a 50 ohm r.f. signal generator and its 50 ohm load; a 72 or 300 ohm antenna and its transmission line, or that same line and the input to a matched r.f. stage; a 600 ohm audio line and its 600 ohm driver transformer. These two types of filter will cover the majority of practical applications.

One fact cannot be overemphasized: *A filter, any filter, will only operate properly when driven from its proper source and into its design load.* Changing either source or load will drastically affect performance, invariably for the worse. The filters given here only perform as predicted when source and load are those of the original design. It is usually best to terminate a filter with a load resistor directly at the load terminals. In high frequency circuits, cables and interconnections can add serious capacity to the apparent load if this is not done. Also, there is a tendency to forget that a specific load is required if it is remote from the filter; an inadvertant change in cable length or an attempt to change system gain can then completely ruin system response.

In cases where non-linear or variable loads must be driven, it is usually best to terminate the filter in a known, fixed load and insert an emitter follower or similar isolation between the filter and the ultimate load.

Part II, will present the actual design procedures and several examples for each type of filter.

[*To be Continued*]

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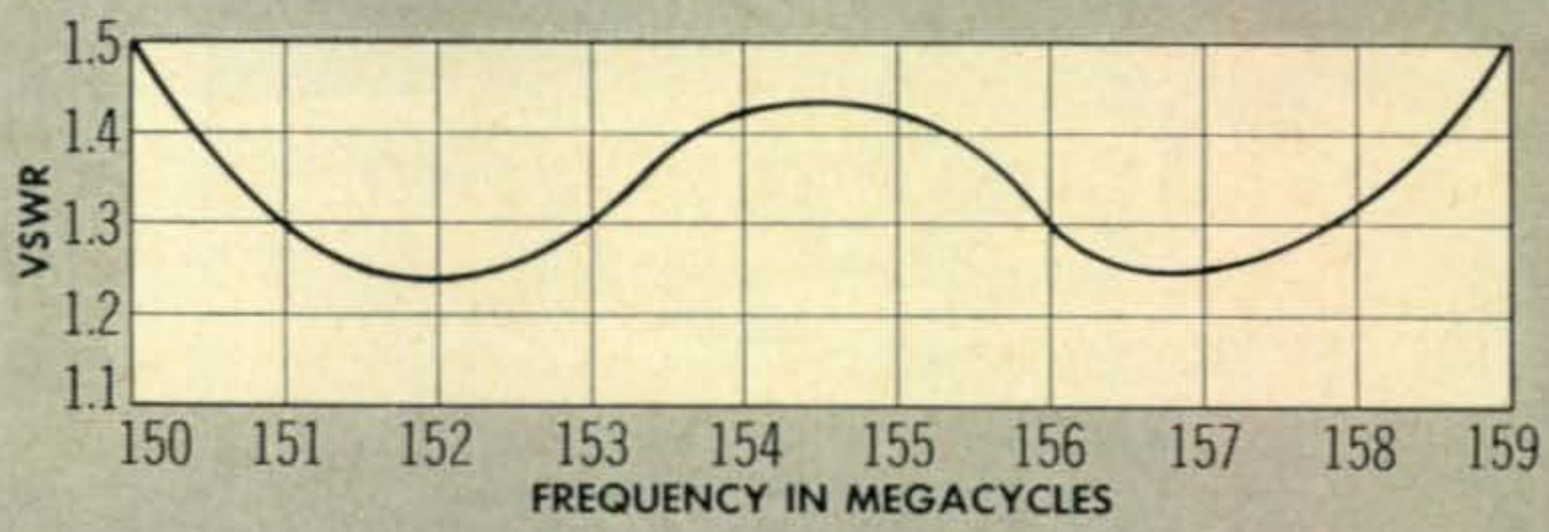

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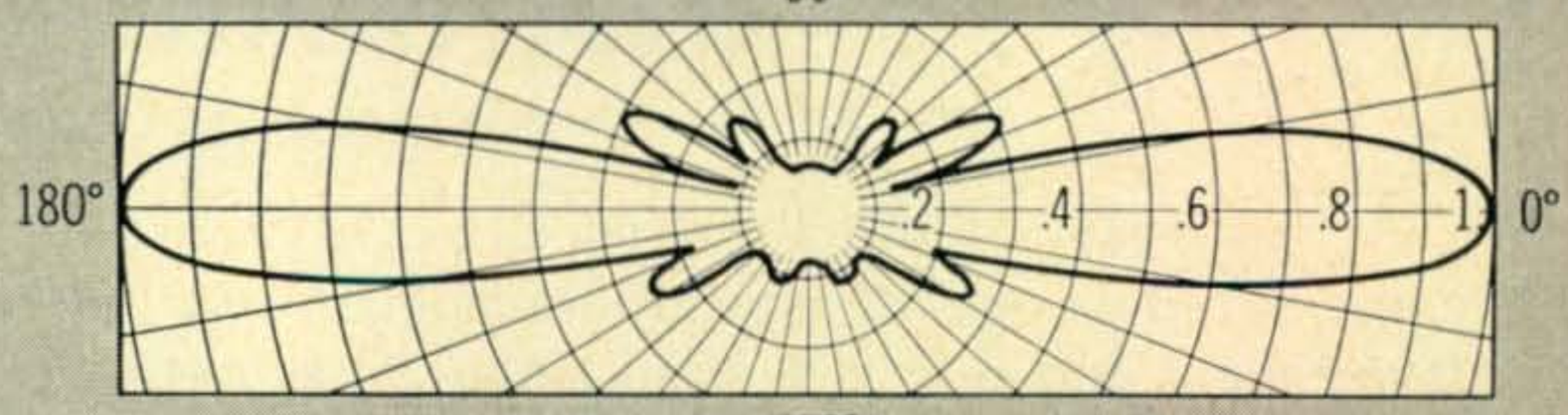

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Because of its exceptional bandwidth, the SUPER STATION-MASTER is produced in three ranges which cover the VHF band, 150 to 159 Mc, 157 to 166 Mc, 165 to 174 Mc.

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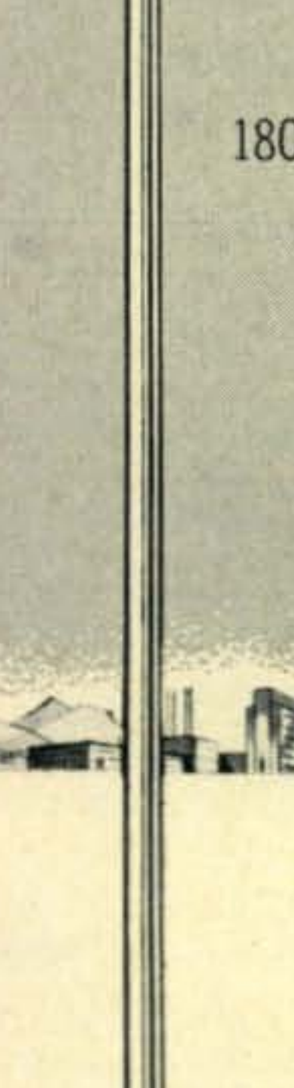

Electrical Specifications

Nominal input impedance	50 ohms
VSWR	1.5:1
Bandwidth	9.0 MC
Maximum power input	500 Watts
Flexible terminal extension	18" of RG 8A/U
Terminations	Type UHF female and Type N male
Vertical beam width (½ power points)	18°
Lightning protection	Direct ground

Mechanical Specifications

Radiating elements	Copper
Element housing material	Fiberglass
Element housing length	20'
Support pipe	2¾" dia. 6061-T6 aluminum pipe
Rated wind velocity	100 MPH
Lateral thrust at rated wind	79 lbs.
Bending moment 1" below ground plane at rated wind	521 ft. lbs.
Weight	30 lbs.

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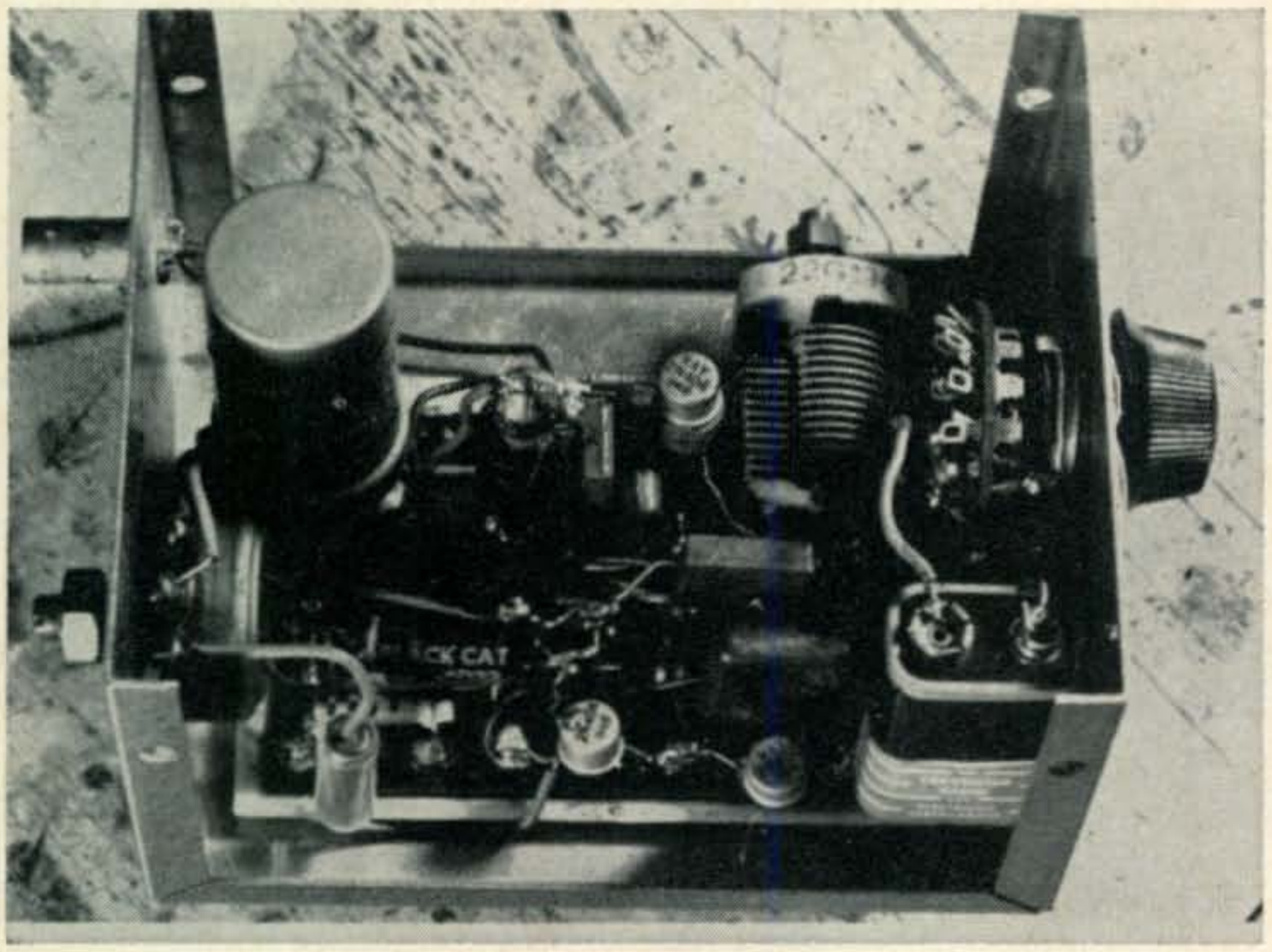


Interior view of the frequency standard. R_1 and the output connector are on the left with the function switch and battery to the left. Y_1 and C_1 are towards the top. C_1 is tuned through a hole in the side of the cabinet.

A SIMPLIFIED FREQUENCY STANDARD

BY ARTHUR C. ERDMAN,* W8VWX

This frequency standard consists of a 100 kc oscillator with a rich harmonic content and a one shot monostable multivibrator for 10 kc pulses. The stability is excellent and both the 100 kc and 10 kc outputs are strong up to 30 mc.

WHEN calibrating a v.f.o. or a receiver, 10 kc marker signals as well as 100 kc marker signals are indispensable. Usually a 100 kc crystal oscillator synchronizes a free-running 10 kc multivibrator. Or as described in a recent article[1], binary circuits with feedback can be used for a 10 to 1 frequency division. The synchronized 10 kc multivibrator features simplicity but can change its frequency division ratio without warning. When transistors are used, a change in temperature can cause a change in the frequency. The binary circuits offer the "perfect" solution to the stability problem, yet is the most complex and costly system. Because a frequency standard is not used regularly by the average constructor, I offer a compromise system that is not too costly. While the frequency division will have to be checked before using, the short term stability is more than adequate.

My standard uses a 100 kc square wave oscillator similar to the one described in a past issue of *CQ*[2]. This square wave is differentiated, clipped and used to drive a 10 kc one-shot (monostable) multivibrator. The one-shot multivibrator is inherently more stable and easier to adjust than the average free-running multivibrator. The reasons for this greater stability will be explained shortly.

Another advantage of the monostable multivibrator used in this manner is the high harmonic content. Most free-running synchronized multivibrators at 10 kc are very low in signal strength above 14 mc. The frequency standard described in this article generates S7 or stronger signals (on an old HRO) up to 30 mc.

Figure 1 shows the complete schematic diagram of the Frequency Standard. Only three inexpensive 2N404 transistors are used.

Construction

The majority of the components are mounted on a terminal board which fits into a Bud Minibox (5 × 4 × 3, CU2105A). The rotary switch, S_1, the frequency adjust potentiometer, R_1, and the output connector are mounted on the walls of the Minibox. The 100 kc fine frequency adjust capacitor, C_1, is simply soldered directly to a lug on the terminal strip. This capacitor is adjusted by placing a hole in the lid of the Minibox that aligns with the tuning capacitor shaft.

The nine volt battery is mounted by soldering stiff leads to its terminals. Perhaps a better method would be to make a mounting strap and use a battery connector.

*241 Garden Road, Columbus, Ohio.

[1]Grigg, J. H., "A Transistor Secondary Standard," *QST*, July 1965, p. 11.

[2]Scherer, W. F., "Harmonic-Rich 100 Kc Calibrator," *CQ*, December 1965, p. 28.

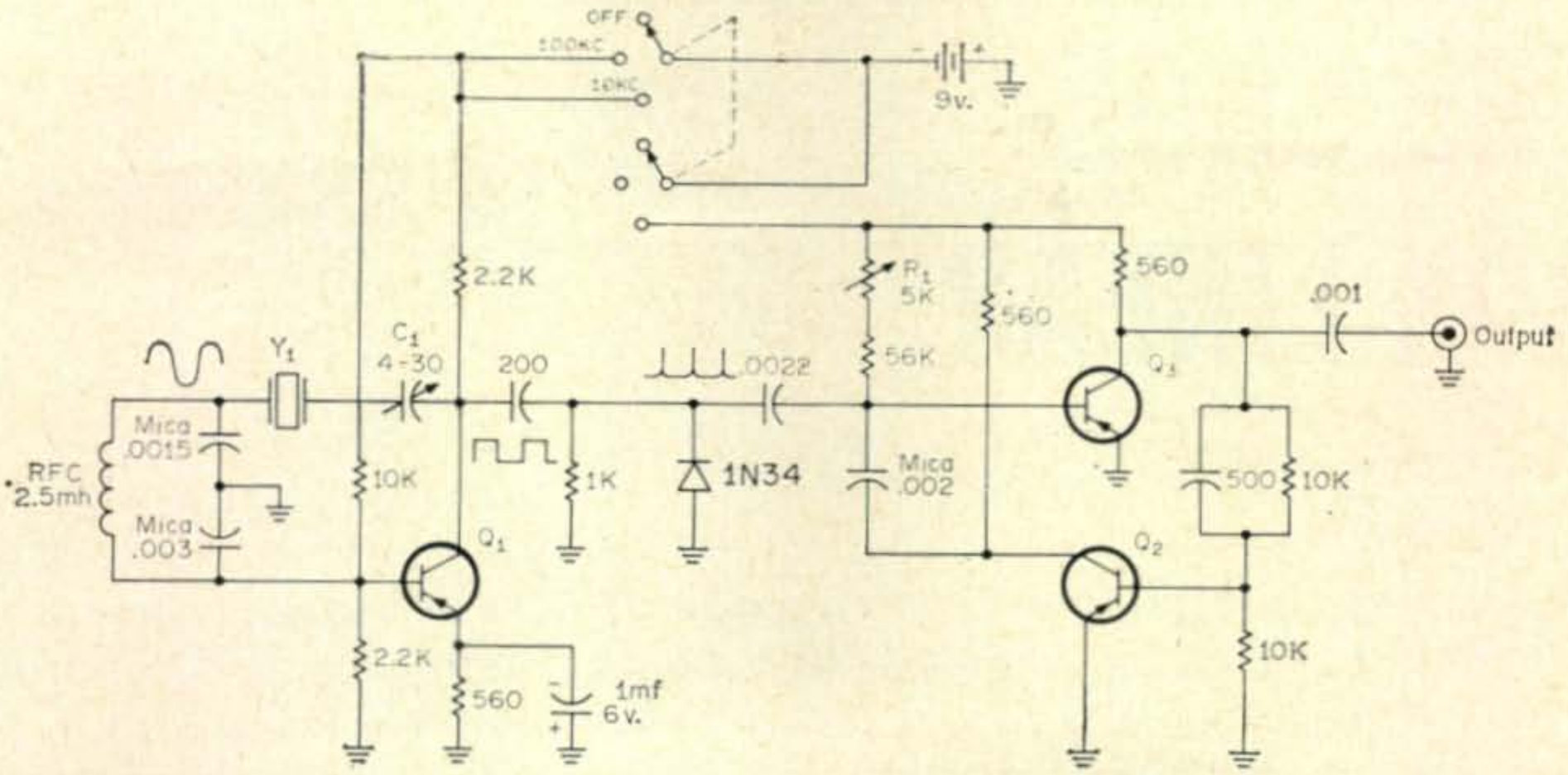


Fig. 1—Circuit of the 100 kc and 10 kc Frequency Standard. All resistors are ½ watt ± 10%. All capacitors greater in value than one are in mmf. Those less than one are in mf unless otherwise noted. Capacitors marked M are micas and all others may be mylar or paper. Crystal Y_1 is a 100 kc unit, Knight H93 or equivalent. All transistors are type 2N404.

Adjustment And Operation

100 KC

1. Tune a receiver to WWV. Have the B.F.O. off.

2. Couple the Standard to the receiver antenna so that both WWV and the Standard have about the same signal strength.

3. With switch S_1 in the 100 KC position, tune C_1 for zero beat on WWV. Be sure WWV has its tone, voice, code and digital data "off" during this adjustment. Because the frequency response of the receiver falls off at the low audio frequencies, it is not possible to obtain "exact" zero beat. However, this error is about ± 20 c.p.s. which is not objectionable to the average constructor. This error is at the particular frequency of WWV. Therefore, for greatest accuracy use the highest frequency of WWV that you can receive. Be sure to use a non-metallic screwdriver for this adjustment.

4. Turn "on" the receiver b.f.o. Find two frequencies that are 100 kc apart and note their dial settings.

10 KC

1. Turn S_1 to the 10 KC position.

2. To avoid hearing a lot of stray beats, set the receiver selectivity to about 2 kc bandwidth. This is not strictly necessary but prevents counting unwanted beats.

3. Count the number of signals heard between the two known 100 kc check points. There should be nine such signals.

4. Adjust R_1 until only nine signals are heard. There is a slight range of adjustment of R_1 over which the frequency remains at 10 kc. This is a favorable feature; adjust R_1 to a midway position in this range. At this position, minor variations in battery voltage and room temperature have no effect on the 10 to 1 frequency division.

The Frequency Standard draws very little current in the 100 kc position. However, in the 10 kc position the average current is about 20 milliamperes. The Standard can be used for hours without any frequency division shift. If the terminal voltage falls below 8 volts, the frequency division *will* shift. I have used this standard to calibrate two receivers and one v.f.o. with no undesirable frequency shift. Because of the rather high battery drain, I usually turn it "off" unless I am actually making a frequency calibration. There is no noticeable frequency shift of the 100 kc crystal oscillator when it is turned on and off at random.

Circuit Description

This crystal oscillator is a Colpitts that uses the crystal in the feedback path. The bias and the collector load resistor are so proportioned that the output is a square wave. This square wave is changed into positive pulses as shown in fig. 1.

Referring to fig. 1 again, Q_2 and Q_3 comprise the one-shot multivibrator. In the absence of

[*Continued on page 104*]

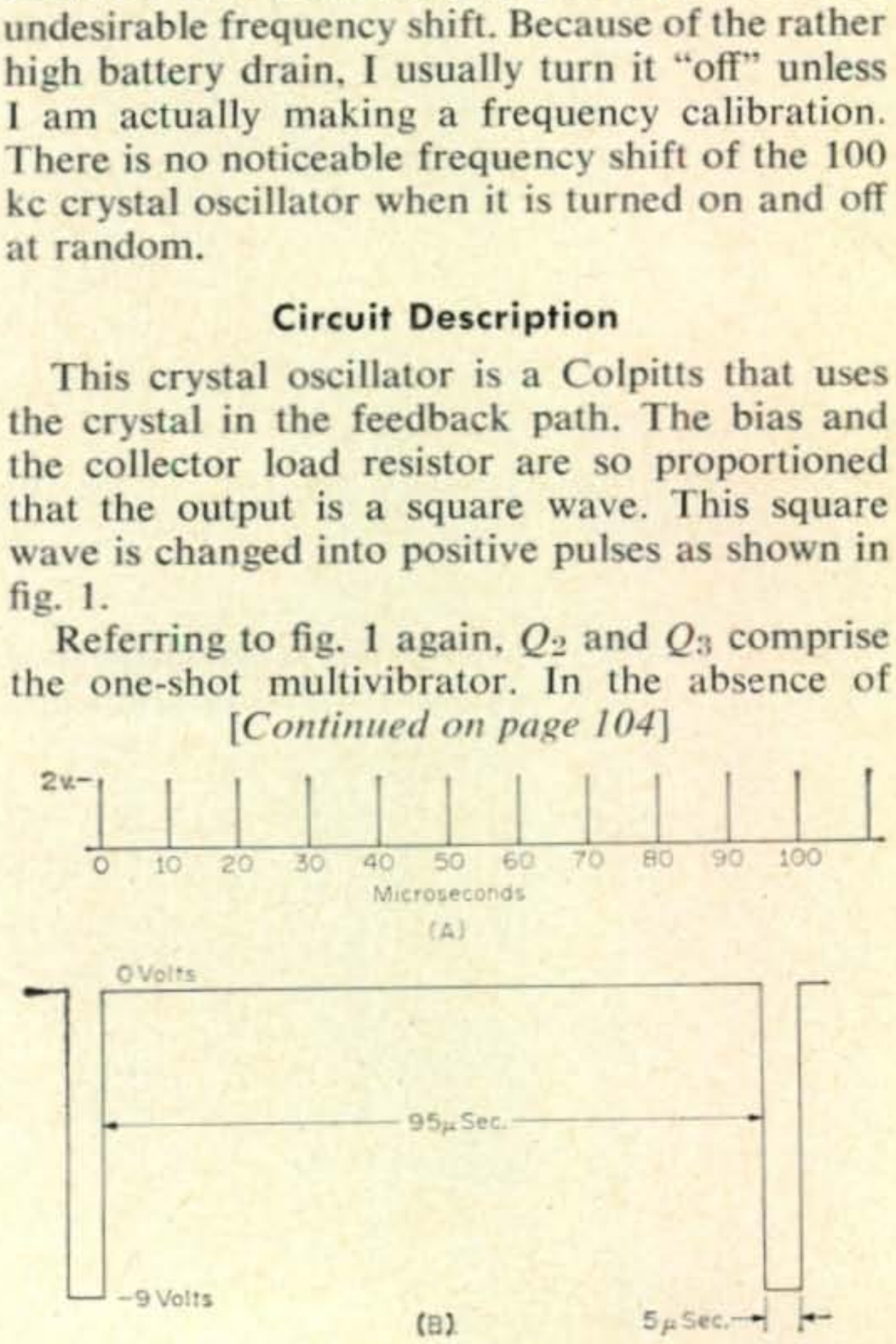
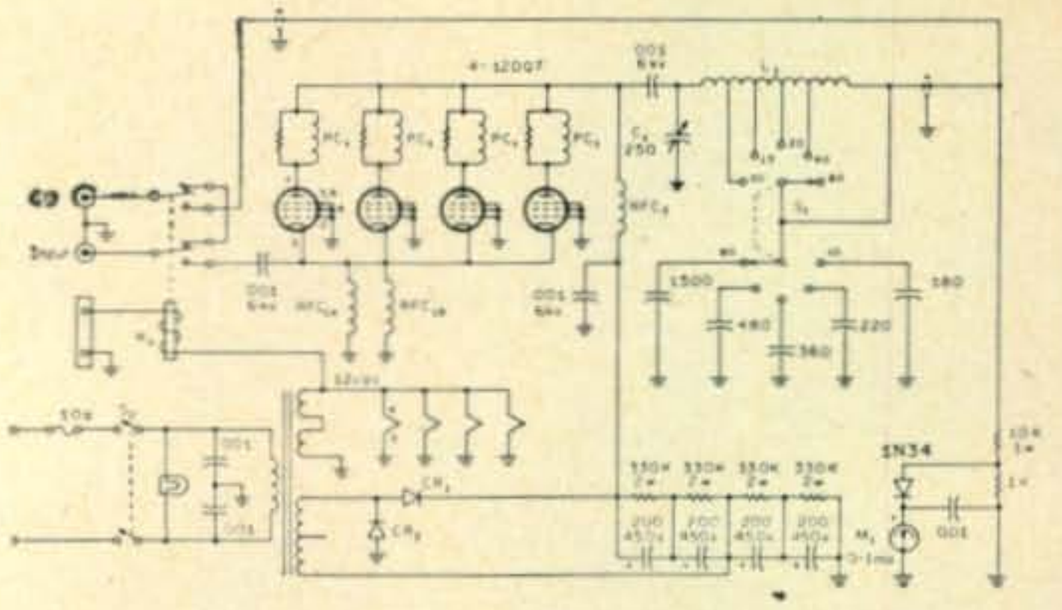


Fig. 2 (A)—Input pulses to the base of Q_3. (B) Output pulses as they appear at the collector of Q_3. The 5 microsecond pulse duration and short rise time produce a high harmonic content.

THE SHOE-BOX LINEAR

BY JOHN SCHULTZ,* W2EEY/1

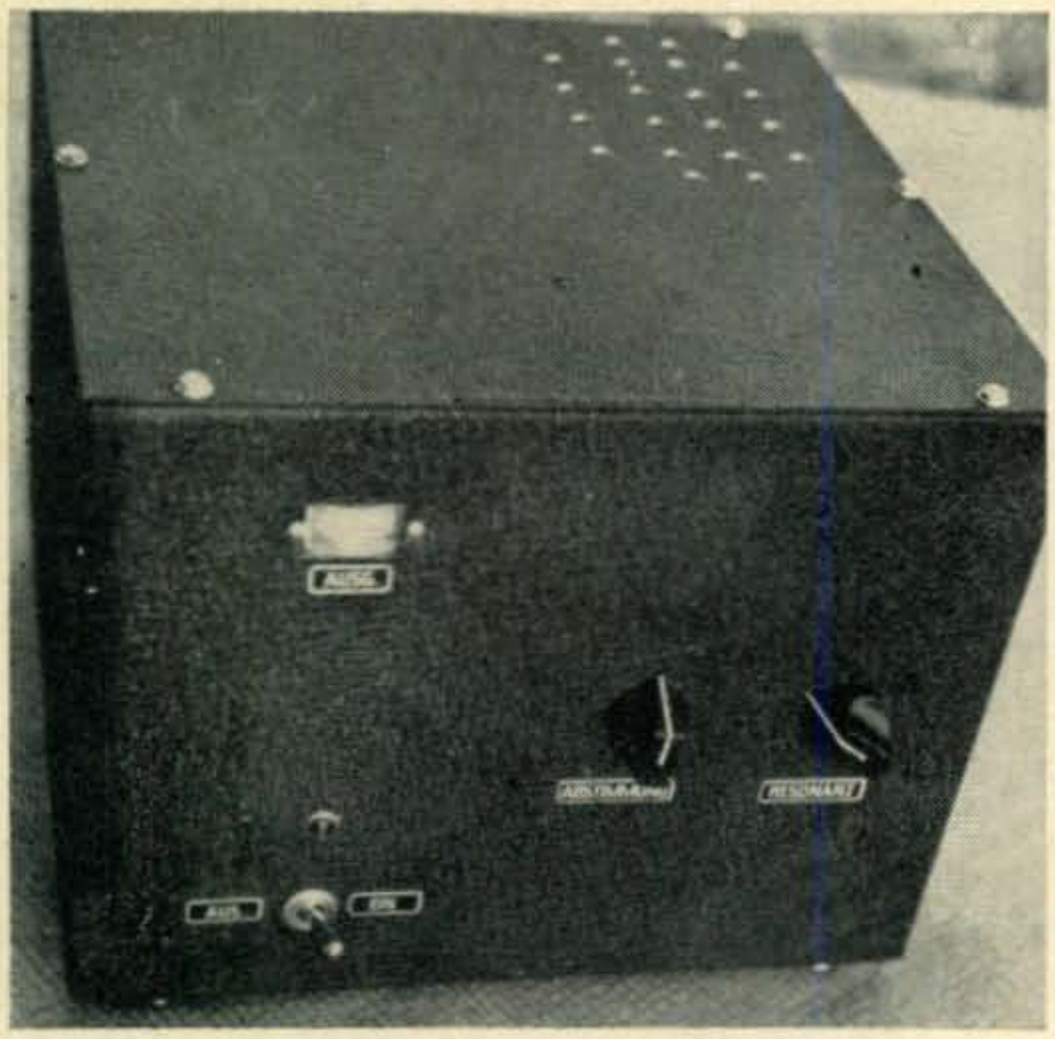


This linear is particularly meant to appeal to the newcomer as a first project. Performance is high (up to 800 watts p.e.p.) but cost is low and construction is particularly simple due to the type of enclosure used.

WRITING an article about a linear amplifier which the newcomer can easily build is quite a challenge these days when it is possible to buy a commercial 1 kw linear for less than $200—with power supply. My own "rule of thumb," which is based mainly on the resale value of "home-brew" versus commercial equipment, is that if I can't buy the parts to build a piece of equipment for 30-40% of the cost of a commercial unit, I begin to seriously consider buying instead of building. However, it is surprising how many pieces of equipment one can still "afford" to build using this "rule of thumb" and derive the satisfaction of being a builder instead of only an operator.

One example, I hope, of such a piece of equipment is the little linear described in this article. Besides using a simple, clean design which holds parts cost to a minimum, it can also be neatly and compactly put together with a very minimum of hand tools. Total parts cost is about $50.

*40 Rossie Street, Mystic, Connecticut 06355.



Front view of the linear cabinet. Front controls are ON-OFF switch, BANDSWITCH and PLATE TUNING capacitor. The Relative output indicator is an imported type of edgewise meter.

General

The schematic of the linear is shown in fig. 1. It is a completely conventional grounded grid circuit with a bandswitched pi-network output. The 12DQ7 tubes are designated in the schematic but 6FH5's, 6JE6's, 837's or any similar tubes which have been used for grounded-grid linears would be suitable.

Filament power and high voltage are supplied from a TV power transformer used in a voltage doubling circuit with high output capacity in order to insure good dynamic regulation. The transformer must be chosen, as noted in the parts list, to give the correct plate voltage for the tubes used (either 800 or 1200 volts). These transformers are ideal low-cost units for use in voltage doubling circuits because of their combination of low total secondary voltage and high current rating.

With four of any of the tubes mentioned, power input will run about 800 watts p.e.p. and 400 watts c.w. with driving powers of 20 to 30 watts. Five or six tubes could be paralleled for 1 kw input without any component changes but such a small power increase is hardly worthwhile.

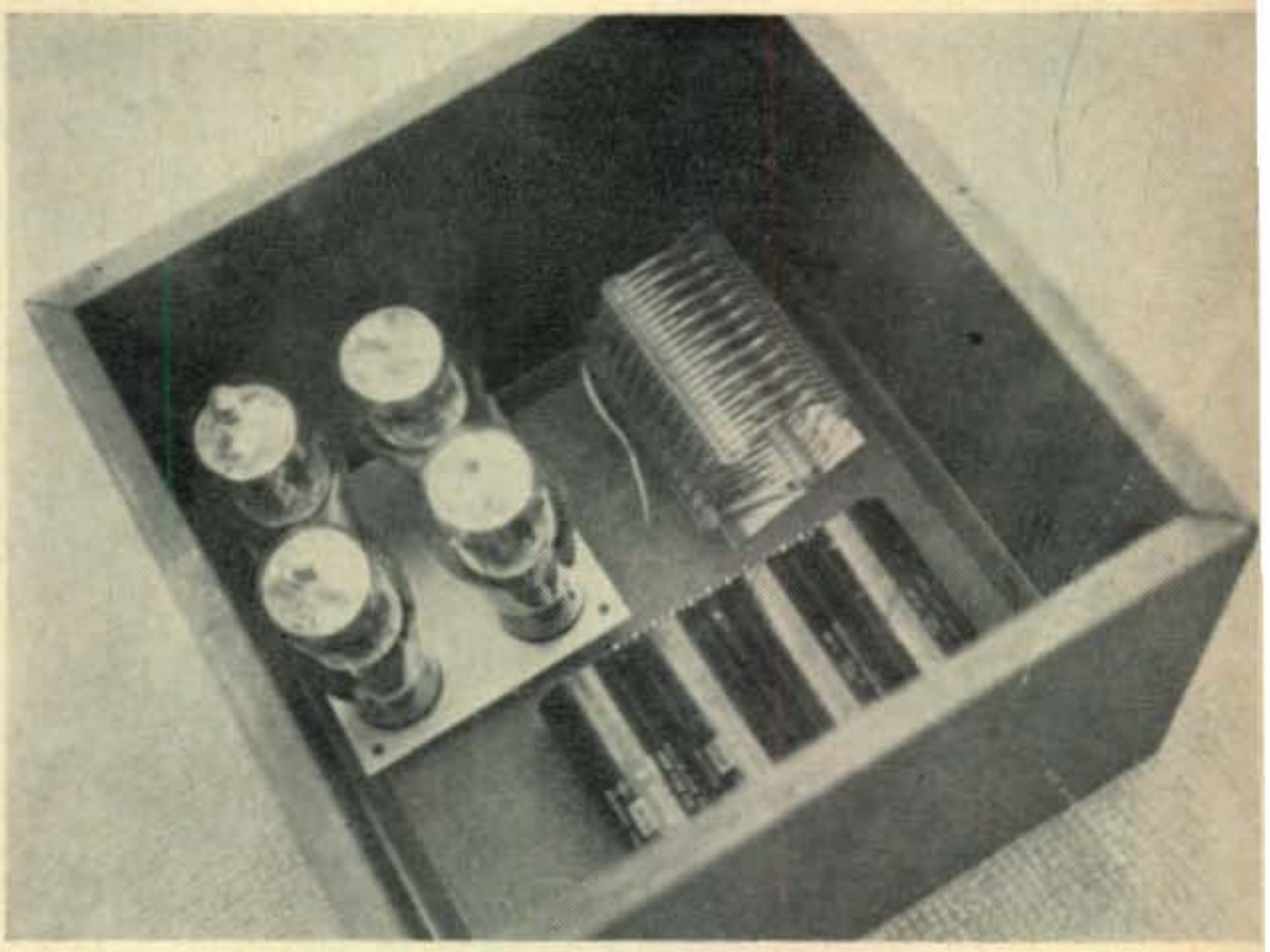
Only one meter is used to measure relative power output. The actual d.c. input can be checked once with a multimeter for information purposes but, in operation, the relative power output is the most useful indication.

The antenna change-over relay will automatically bypass the linear when its a.c. power is switched off.

Construction

The linear is constructed in a steel 8 × 10 × 10 inch standard utility cabinet (Premier C-8101). The use of an aluminum cabinet is not suggested. One of the reasons for the simplicity of construction is that almost all the components can be mounted directly on the cabinet walls. An aluminum cabinet is not strong enough, especially for the power transformers. Also, the steel cabinet comes with a black wrinkle finish (versus unpainted aluminum), is not more ex-

The components are placed in the cabinet to show relative room. The tubes shown are 837's but 12DQ7's are indicated in the schematic as they are more readily available.



pensive and easy to work mechanically since only hole drilling and some filing is necessary to mount the components.

Start out by placing the components in the cabinet and checking dimensions. Some minor rearrangement may be necessary from the general layout shown in the photograph. Once the layout is finalized, drill all mounting holes and a pattern of ventilation holes on the top cover over the tube area.

The cabinet lends itself to a very simple wiring procedure. With both covers removed for accessibility, the components around the walls of the cabinet are mounted and wired (relay, plate circuit, pi-network, etc.). The components for the output meter circuit are mounted on a miniature terminal strip which is supported by one of the meter mounting screws. The pi-network coil is supported by its leads to the bandswitch and plate tuning capacitor. The output loading capacitors connect to a ground lug on the bandswitch. The plate bypass capacitor similarly connects to a ground lug mounted at the plate choke base.

The tube sockets may be mounted on a 4 × 4 inch aluminum plate which is supported by ¾ inch standoffs from the bottom cover or they may simply be individually mounted on standoffs and the cathode chokes wired to the ground lugs on the sockets. The filter capacitors and diodes for the power supply are connected to alternate terminals of the 10 lug terminal strips.

After both cabinet walls and the covers are wired, the two units are screwed together and the transformer and relay wiring completed.

Testing and Operation

Without the tubes in place, check to see that

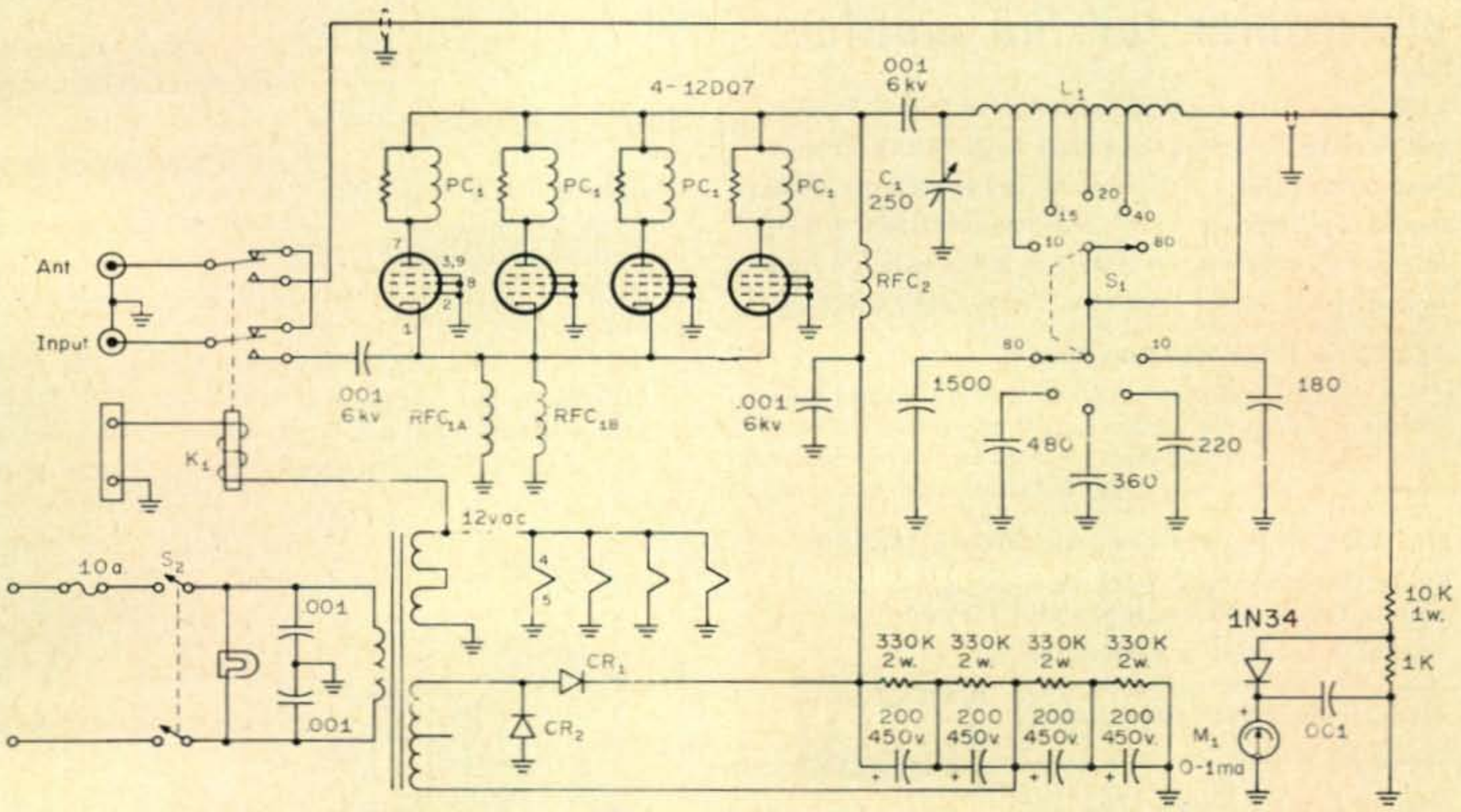


Fig. 1—Circuit of a simple low-cost 800 watt p.e.p. linear amplifier suitable for the beginner. All resistors are ½ watt and all capacitors disc ceramic (600 volts) unless otherwise noted.

C_1—Hammarlund MC250M or MC325M.
CR_1, CR_2—Silicon diodes 1600 p.i.v., 750 ma.
K_1—d.p.d.t. 12 v. ac. relay.
L_1—16 t, 2¼" dia., 4 t.p.i., tapped at 2, 3, 5 and 10 turns.
PC_1—4 t, #18, spaced ½", wound on 47 ohm 2 watt resistor.
RFC_1—1 mh, 300 ma (two in parallel).
RFC_2—1 mh, 600 ma. National R154U or equiv.
S_1—2 pole, 5 position rotary ceramic. Mallory 4M2116H or equiv.
T_1—TV type power transformer, 450 v.c.t. (for 800 bolt d.c.) or 650 v.c.t. (for 1200 v.d.c.) at 250 ma. Two 6.3 volt windings at 2 amps each.

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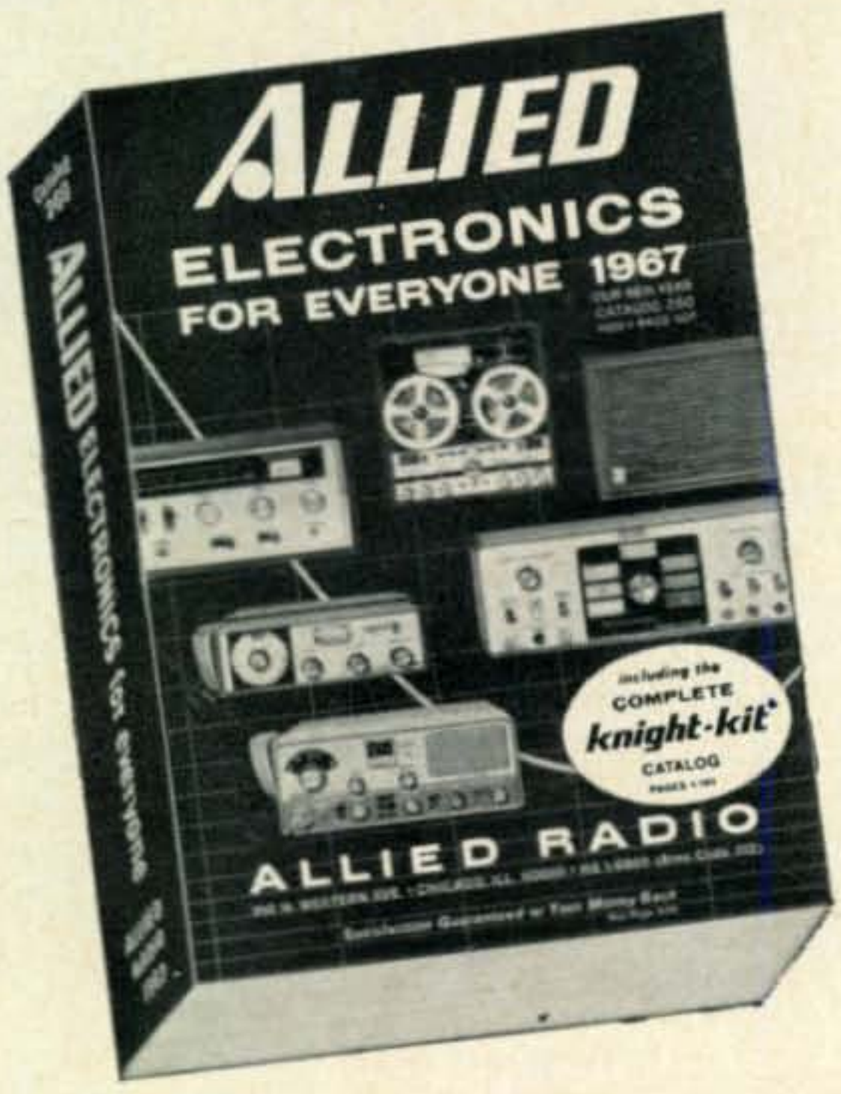

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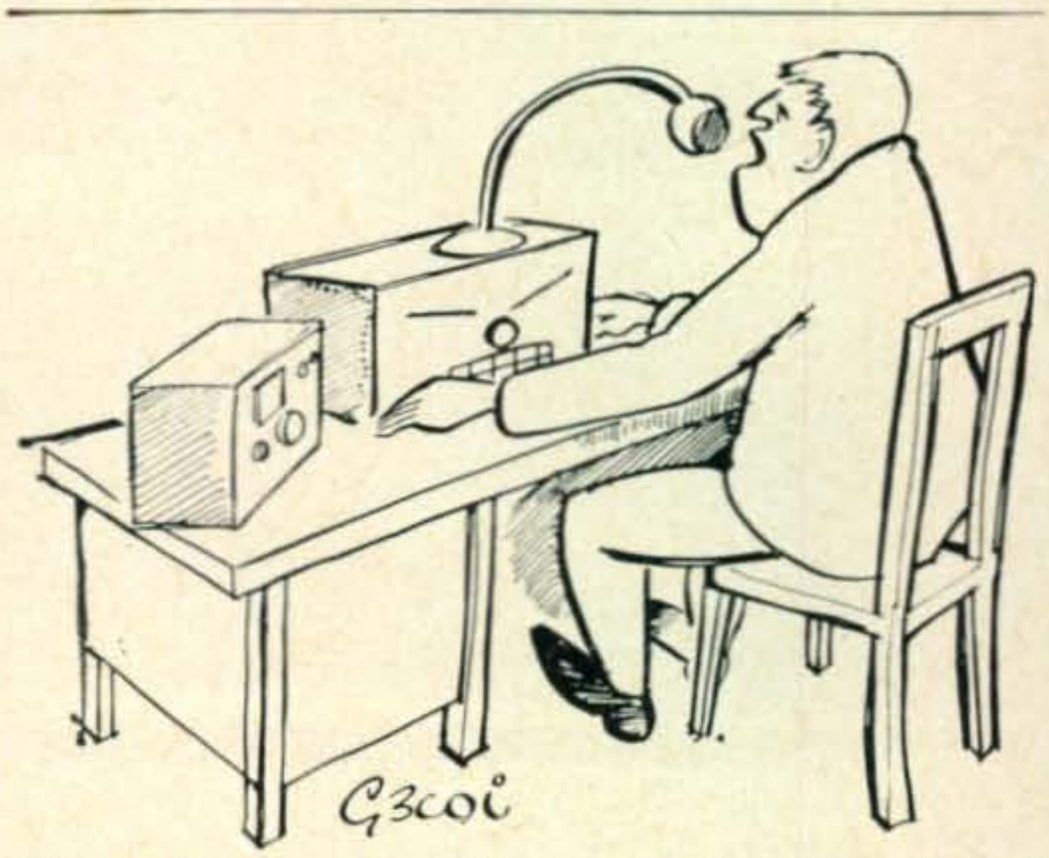
Rear view showing the transformer mounted thru the cabinet. The jacks are top to bottom: input, output, and control. It is suggested that SO-239s be used in place of the phono jacks.

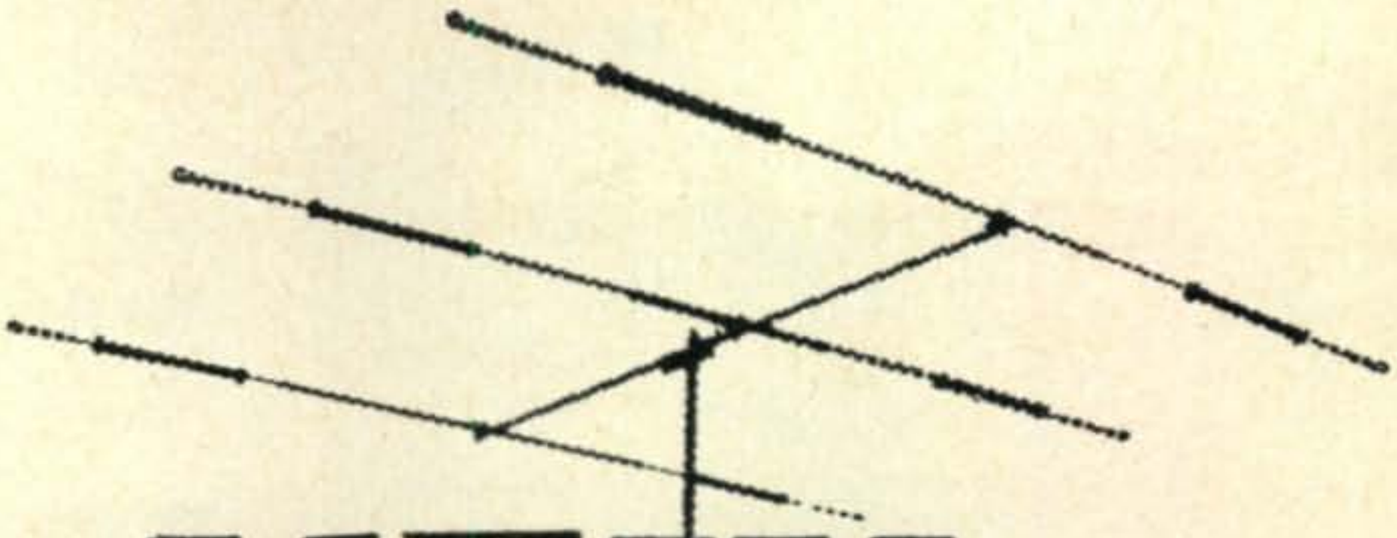
the filament and plate voltages are proper and that the antenna relay is operative. With the tubes installed and a multimeter used to measure plate current, check the unloaded amplifier for parasitics by rotating the plate tuning capacitor through its entire range in each bandswitch position. If any parasitic is indicated (sudden rise in plate current), slightly change the spacing of the parasitic plate chokes until the parasitic disappears. The standby and loaded plate currents depend, of course, on the tubes used. In general, standby current is 40-60 ma. and c.w. current runs up to 400 ma for 1200 volt tubes (837, 12DQ7) and 600 ma for 800 volt tubes (6FH5, 6JE6).

The plate tuning capacitor is simply tuned for maximum r.f. output on each band. The output load must be 50-70 ohms at a low s.w.r. (2:1 or less). With some tubes on 10 and 15 meters the taps given for the pi-network coil may not provide a peak in the r.f. output when the plate capacitor is tuned. The tap should be changed a half turn at a time until such a condition is secured.

In case you're wondering about the title, I intended to name the amplifier the Kleinboomer. However, my XYL upon seeing it from a distance thought it looked like a black shoebox! ■



"The receiver here is a Chinese copy of a Japanese rig."



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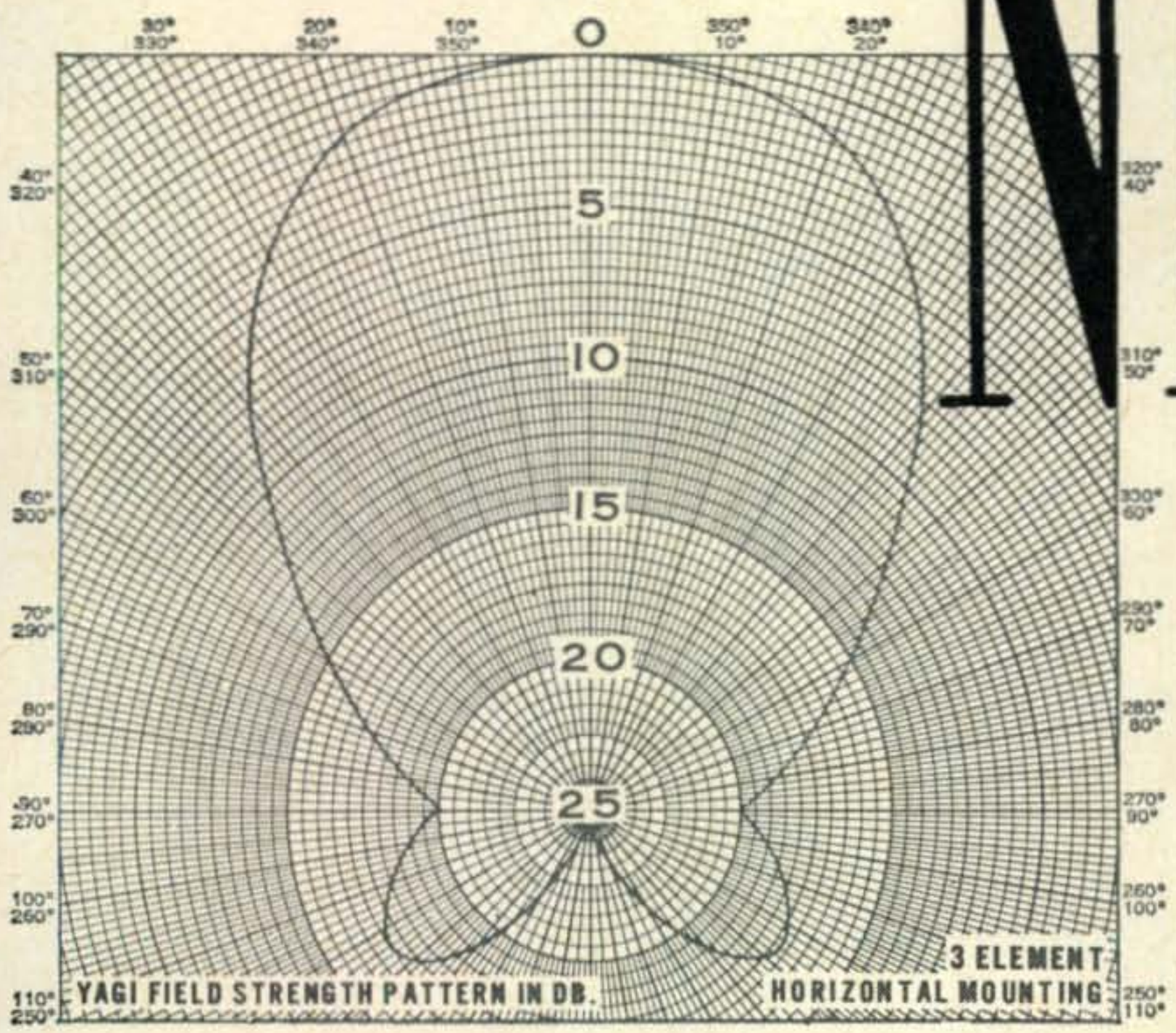

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Fig. 11—The CQ-150, a globe girdling, bandswitched 150 watt c.w. transmitter for 80 and 20 meters.

THREE STEPS TO SIDEBAND

BY HARTLAND B. SMITH,* W8VVD

Part 2: The CQ-150

The second part of a three part series detailing the construction of an s.s.b. transmitter modifies the CQ-90 to include a v.f.o. and 80 and 20 meter coverage. The input power to this c.w. transmitter is now raised from 90 to 150 watts. Part III will describe the addition of the sideband circuits.

THE bandswitching 150 watt c.w. transmitter illustrated in fig. 11 is the second of three successive units designed to ultimately put you on single sideband in the least complicated, most economical fashion. Known as the CQ-150, it is a modified version of the CQ-90 described last month and contains three important added features: 1) a v.f.o., 2) 20 meter coverage, 3) higher input power.

The new transmitter's v.f.o. is extremely stable. Average drift, after a three minute warmup is no more than 15 c.p.s. per quarter hour. Only the most expensive factory built ham equipment approaches this degree of performance.

At a flick of its two bandswitches, you can either chat around the States on 80 meters or try your luck at contacting the other side of the globe on 20. Thanks to its increased power rating of 150 watts, the transmitter generates a truly husky signal that falls shy of the legal limit by a mere 1½ S-units.

Does it really work? Definitely! On 20 meters, with its very first transmission, the prototype snagged a DL8 in Germany. A few days later, despite the monstrous QRM accompanying an ARRL DX Contest, Denmark, Czechoslovakia, Finland, Bermuda, Sweden, France, Russia, Panama, Switzerland, England, Hungary, Netherlands, Austria, Malta and the Ukraine were easily added to its list of conquests. And all this was accomplished with an inefficient, half-sized two element antenna mounted just forty feet off the ground!

About The New Circuit

A second bank of diodes, CR_7-CR_{12}, converts the power supply from a conventional full-wave rectifier to a combination bridge and full-wave circuit which provides, under load, 700 volts to the plate of V_2 and 350 volts for the balance of the tubes. V_2 is changed from a grid leak biased Class C amplifier to a Class AB_1 linear that receives fixed bias from a d.c. supply consisting of T_2, CR_{14}, C_{57}, R_{38}, R_{39} and R_{40}. For safety's sake, high voltage switching is accomplished with K_1, a 6 volt d.c. relay. Power to operate the relay is obtained by tieing the 6.3 and 5 volt windings of T_1 in series and then rectifying the output with CR_{13} and filtering it with C_{56}. Resistor R_{37} prevents arcing in the points of SEND-RECEIVE switch, S_1, or ZERO-OPERATE switch S_2. A fast acting fuse in the cathode lead of V_2 protects both the tube and M_1 from accidental overloads.

The grid and plate circuits of V_2 are bandswitched to either 80 or 20 meters. V_1 is converted from a crystal oscillator to a cathode keyed linear driver stage. Two new tubes are added. Part of V_4, a 6JH8, is wired as a 9.0015 mc crystal controlled oscillator. The remaining elements in this sheet beam tube will be put to work as a balanced modulator in the Mark II version of the transmitter which will be described next month.

One section of V_5, a dual pentode Compactron, serves as a variable frequency oscillator tuning from 4.9985 mc to 5.5015 mc. Output from the crystal oscillator is fed, via C_{28}, to the grid of V_{5b}. Energy from the v.f.o. reaches the same grid via C_6. The two signals are mixed in this stage to produce energy at approximately 4 mc, or 14 mc, depending on whether L_4 or L_5 is switched into use. The resulting signal is then amplified at the operating frequency by V_1 and V_2.

The actual transmitting frequency depends on the setting of C_{29} and is equal to either the sum

*467 Park Avenue, Birmingham, Michigan 48009.

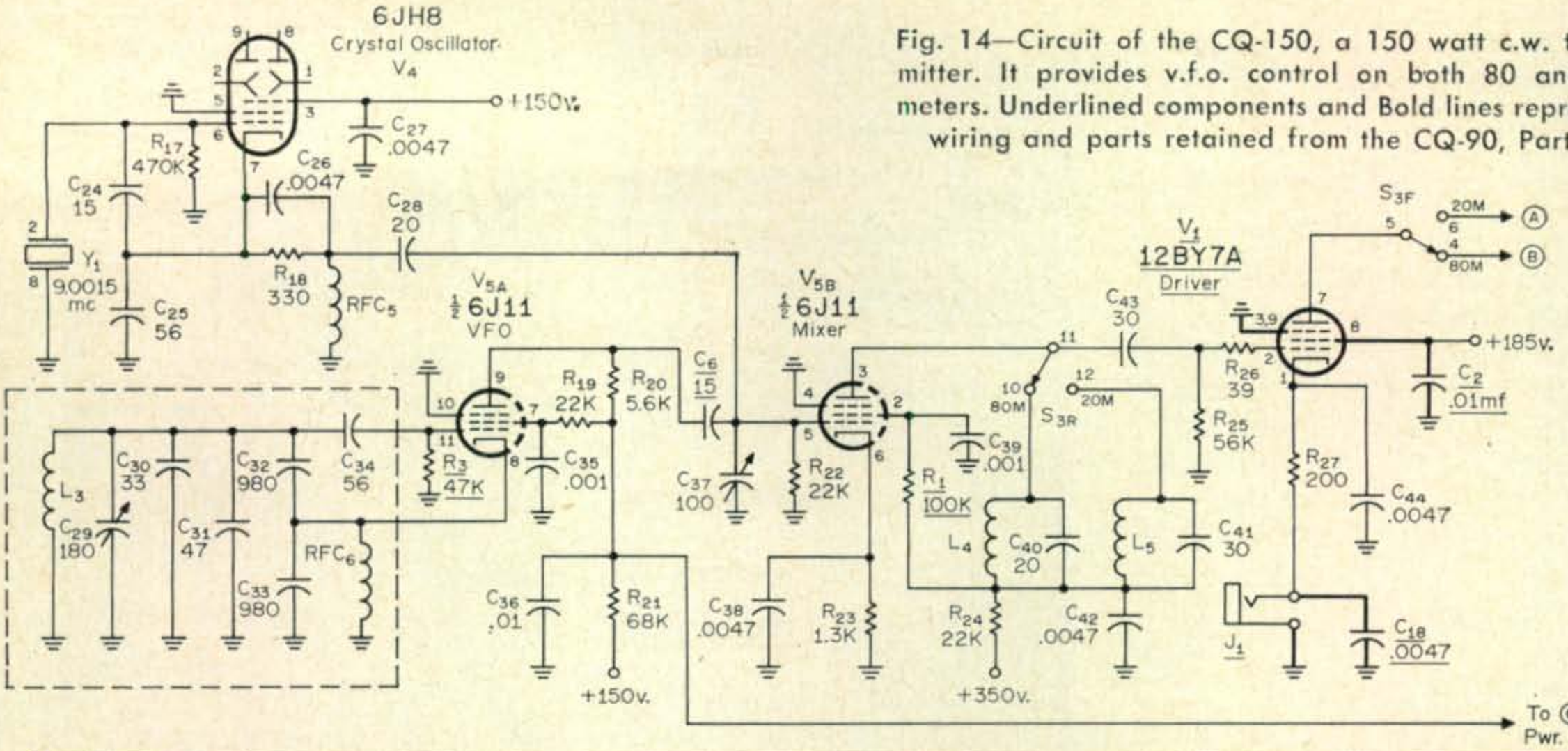


Fig. 14—Circuit of the CQ-150, a 150 watt c.w. transmitter. It provides v.f.o. control on both 80 and 20 meters. Underlined components and Bold lines represent wiring and parts retained from the CQ-90, Part I.

Parts List

C_{24}—15 mmf tubular ceramic capacitor.
C_{25}—56 mmf tubular ceramic capacitor.
C_{26}, C_{27}, C_{38}, C_{42}, C_{44}, C_{45}—.0047 mf disc ceramic capacitor.
C_{28}, C_{40}—20 mmf tubular ceramic capacitor.
C_{29}, C_{49}—180 mmf variable capacitor (Allied Radio 13U524 with 10 rotor plates removed).
C_{30}—33 mmf NPO disc ceramic capacitor. Sprague 10TCCQ33 or equiv.
C_{31}—47 mmf N750 disc ceramic capacitor. Sprague 10TCUQ47 or equiv.
C_{32}, C_{33}—980 mmf NPO disc ceramic capacitor (See Text).
C_{34}—56 mmf NPO disc ceramic or silver mica capacitor.
C_{35}, C_{39}, C_{46}—.001 mf disc ceramic capacitor.
C_{36}, C_{53}—.01 mf, disc ceramic capacitor.
C_{37}—100 mmf mica trimmer capacitor.
C_{41}, C_{43}—30 mmf tubular ceramic capacitor.
C_{47}—470 mmf disc ceramic capacitor. Sprague 10TST47 or equiv.
C_{48}—.0033 mf disc ceramic capacitor.
C_{50}—56 mmf disc ceramic capacitor.
C_{51}—480 mmf mica trimmer capacitor.
C_{52}—4.7 mmf NPO disc ceramic capacitor. Sprague 10TCCV47 or equiv.
C_{54}—510 mmf mica capacitor. El Menco CM-30-B511M or equiv.
C_{55}—40 mf, 450 volt electrolytic capacitor.
C_{56}—100 mf, 25 volt electrolytic capacitor.
C_{57}—100 mf, 150 volt electrolytic capacitor.
CR_7, CR_8, CR_9, CR_{10}, CR_{11}, CR_{12}, CR_{13}, CR_{14}—500 ma, 400 p.i.v. silicon diodes.
K_1—3 p.d.t. 6 v.d.c. relay. Potter Brumfield KA14DY or equiv.
L_3—15 turns, #18 wire on a ¾" diameter ceramic form. Coil length, 2". (XL-2 coil, $1.75, postpaid, from Harrington Electronics, Topsfield, Massachusetts).
L_4—90 turns, #28 enamel wire closewound on slug tuned form previously used for L_1.
L_5—16 turns, #28 enamel wire closewound on a J. W. Miller 21AOOORBI ⅜" × 1⅛" form.
L_6—**Secondary**: 40 turns, #28 enamel wire closewound on a ½" diameter polystyrene tube. **Primary**: 11 turns #28 wire closewound over secondary. Windings insulated from each other with one layer of plastic tape.
L_7—**Secondary**: 9 turns, #28 enamel wire spaced diameter of wire on a ½" diameter polystyrene tube. **Primary**: 9 turns, #28 enamel wire spaced diameter of wire wound over secondary. Windings insulated from each other with plastic tape.
L_8—9 turns, #18 wire, 1¼" diameter, spaced diameter of wire. Barker-Williamson 3018 Miniductor or equiv.
L_9—20 turns, #20 wire, 1¼" diameter, spaced diameter of wire. Barker-Williamson 3019 Miniductor or equiv.
R_{17}—470,000 ohm, ½ watt resistor.
R_{18}—330 ohm, ½ watt resistor.
R_{19}, R_{22}, R_{39}—22,000 ohm, ½ watt resistor.
R_{20}—5600 ohm, ½ watt resistor.
R_{21}—68,000 ohm, 1 watt resistor.
R_{23}—1300 ohm, ½ watt resistor.
R_{24}—22,000 ohm, 1 watt resistor.
R_{25}, R_{40}—56,000 ohm, ½ watt resistor.
R_{26}—39 ohm, ½ watt *composition* resistor.
R_{27}—200 ohm, 1 watt resistor.
R_{28}—1000 ohm, 1 watt resistor.
R_{29}—18 ohm, 1 watt *composition* resistor.
R_{30}—500,000 ohm volume control with switch.
R_{31}, R_{32}, R_{33}, R_{34}, R_{35}, R_{36}—220,000 ohm, ½ watt resistor.
R_{37}—56 ohm, 1 watt resistor.
R_{38}—120 ohm, ½ watt resistor.
RFC_5, RFC_6—2.5 mh, 125 ma r.f. choke.
S_3—2 section, 8 pole, 2 position non-shorting phenolic rotary switch. Centralab PA-1025 or equiv.
S_4—3 pole, 5 position, non-shorting steatite rotary switch. Centralab PA-2007 or equiv.
S_5—S.p.s.t. switch (part of R_{30}).
T_2—6.3 v., 1.2 amp. filament transformer. Knight Allied Radio 61Z419 or equiv.
V_4—6JH8 tube.
V_5—6J11 tube.
F_2—8AG, ½ amp. fuse.

Misc.

1—Socket for F_2.
1—9 prong miniature tube socket with shield base. Amphenol 59-406 or equiv.
1—tube shield for above. Amphenol 5-409 or equiv.
1—12 pin Compactron socket for 6J11. Eby 9371 or equiv.
1—Loktal socket. Amphenol 78S8L or equiv.
5—Knobs.
Extension shaft and coupler for S_3.
½" diameter polystyrene tubing or rod.
1—6" × 5" × 4" Black wrinkle utility cabinet. Bud CU-729.

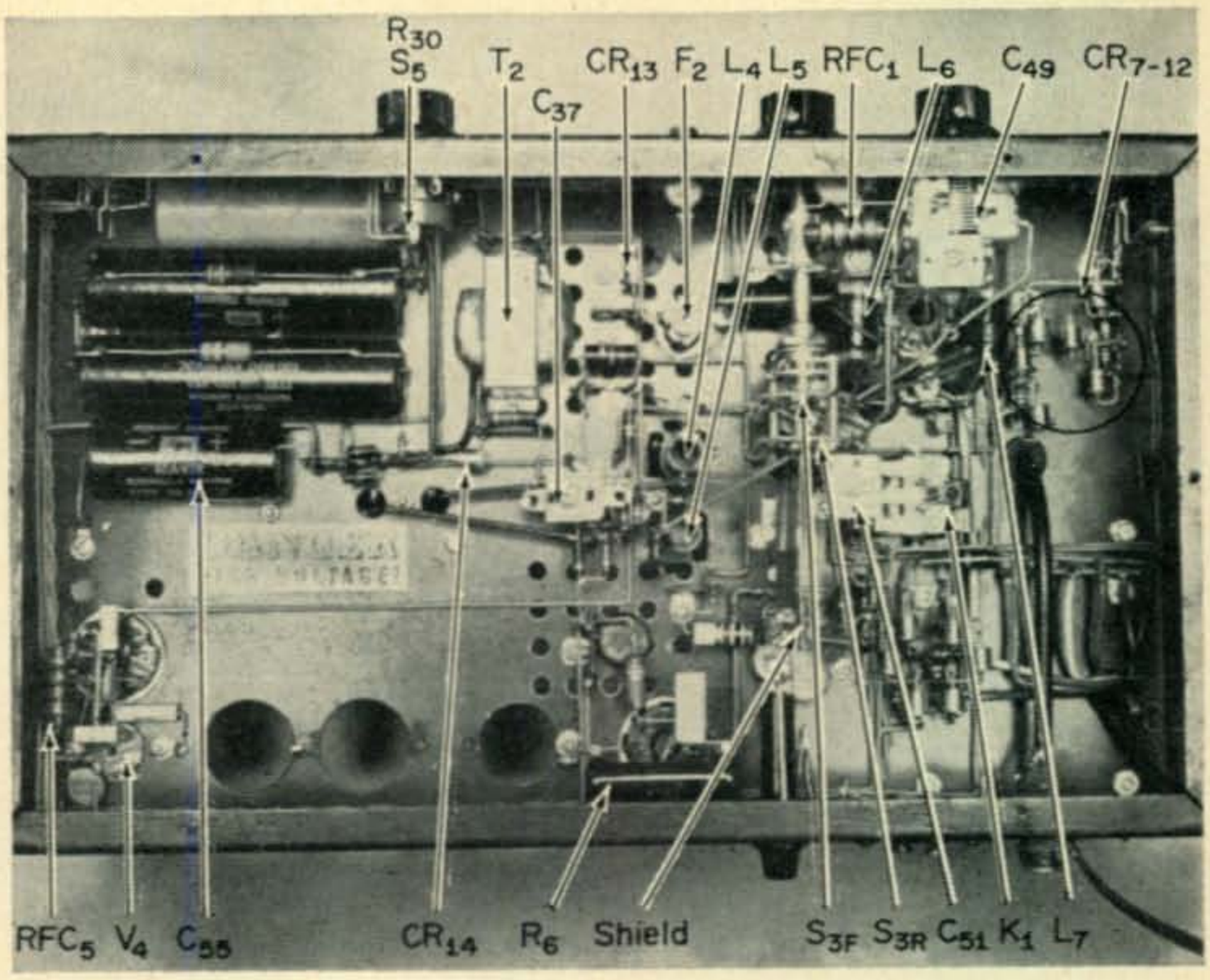


Fig. 12—Bottom view of the chassis with the location of major components pointed out.

of, or difference between the v.f.o. frequency and 9.0015 mc. To transmit on 3.6 mc, for example, the v.f.o. is tuned to 5.4015 mc (9.0015 minus 5.4015 equals 3.6). To work 14.050 mc. the v.f.o. is set at 5.0485 mc (9.0015 plus 5.0485 equals 14.050).

Mixing results in a very stable signal, even at 14 mc, because the reference frequency (9.0015 mc) is crystal controlled and the v.f.o. frequency is heterodyned rather than multiplied as in conventional c.w. transmitters.

Starting The Conversion

Don't let the apparent complexity of fig. 14 frighten you. The bold inked lines identify parts and circuitry of the CQ-90 which are retained in the CQ-150. New components and wiring are shown with normal lines. Keep in mind that you don't have to do all of this new wiring at once. Instead, you can add parts, a stage at a time, and then test for satisfactory performance before proceeding with the next section.

Remove C_1, C_3, C_4, L_2 and the octal socket shown in fig. 3 of Part I. File these in your junk box for a future project. Unsolder C_5, C_6, R_1, R_3 and RFC_1. Keep them close at hand, because they'll be put to use in the CQ-150. Remove the winding from L_1, but save the form. You'll need it as a foundation for L_4. Discard all other PE-90 wiring which does not appear in fig. 14.

Power Supply

With a pair of long nosed pliers, bend up the tail piece on K_1 until barely enough spring tension remains to hold the contact arms in the upper, or de-energized position. Cut off the locating ear on the bottom of the relay. Place a grommet in the 3/8" hole between V_2's socket and the original group of silicon diodes. Insert the relay's mounting stud into the center hole of the grommet. Place a washer and nut over the end of the stud which protrudes above the chassis. After briefing the relay as in fig. 12, tighten the nut until the relay is held firmly in place. However, don't squash the grommet so much that its sound deadening properties are impaired.

Switch S_5 is part of R_{30}, an audio gain control that will be utilized later on, when sideband is added. Install CR_7-CR_{12} as close to the chassis as possible so that there will be clearance for a filter choke that will be mounted on the side of the chassis, near the diodes, in the Mark II version. Transformer T_2 is wired so that low voltage is fed to its secondary and high voltage is taken from its primary. Note that the *positive* terminals of C_{56} and C_{57} go to ground.

The 6.3 and 5 volt windings of T_1 must be wired to reinforce, rather than buck, each other. When power is applied to the transmitter, if K_1 fails to close after S_1 or S_2 is thrown, reverse the two yellow transformer leads.

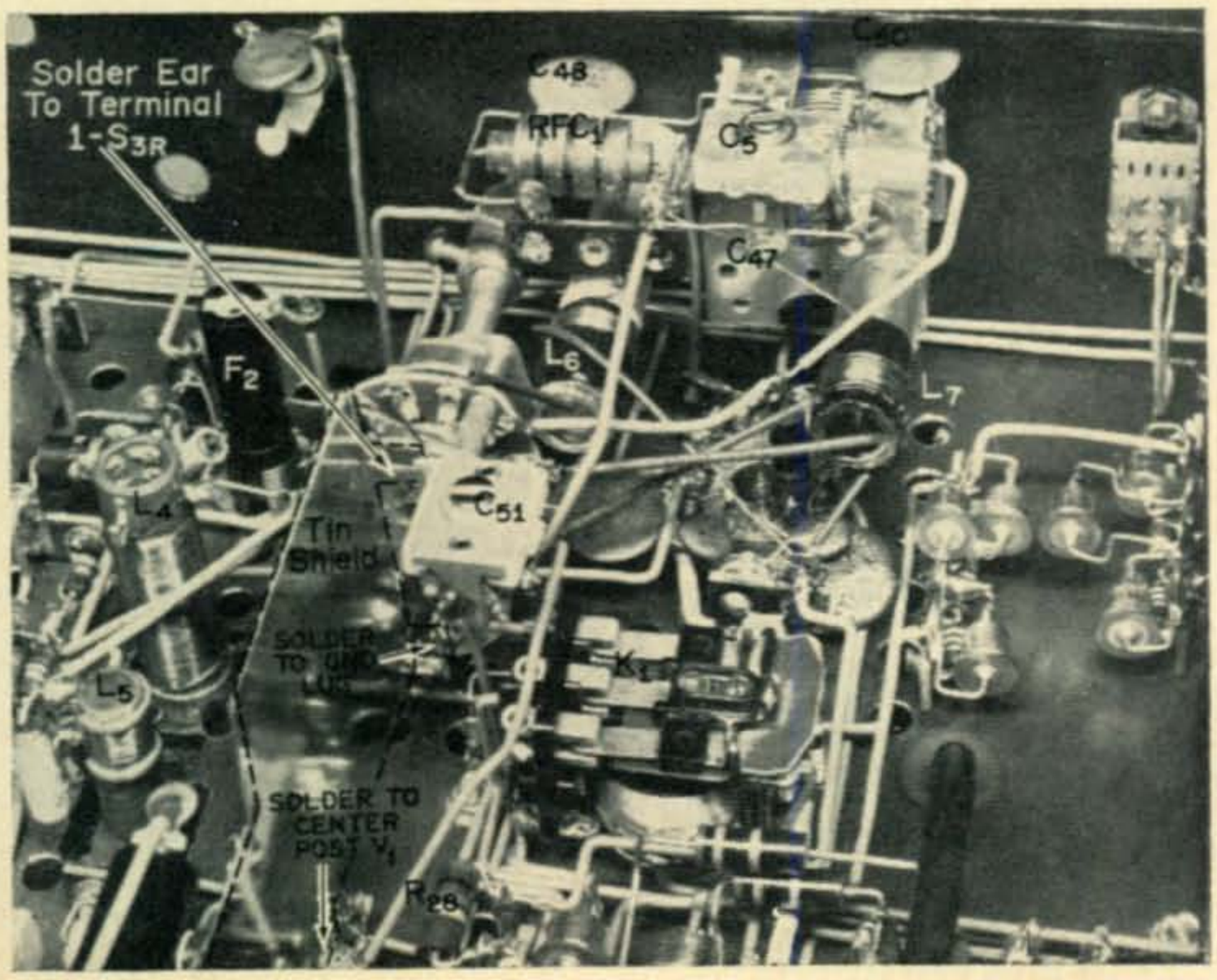
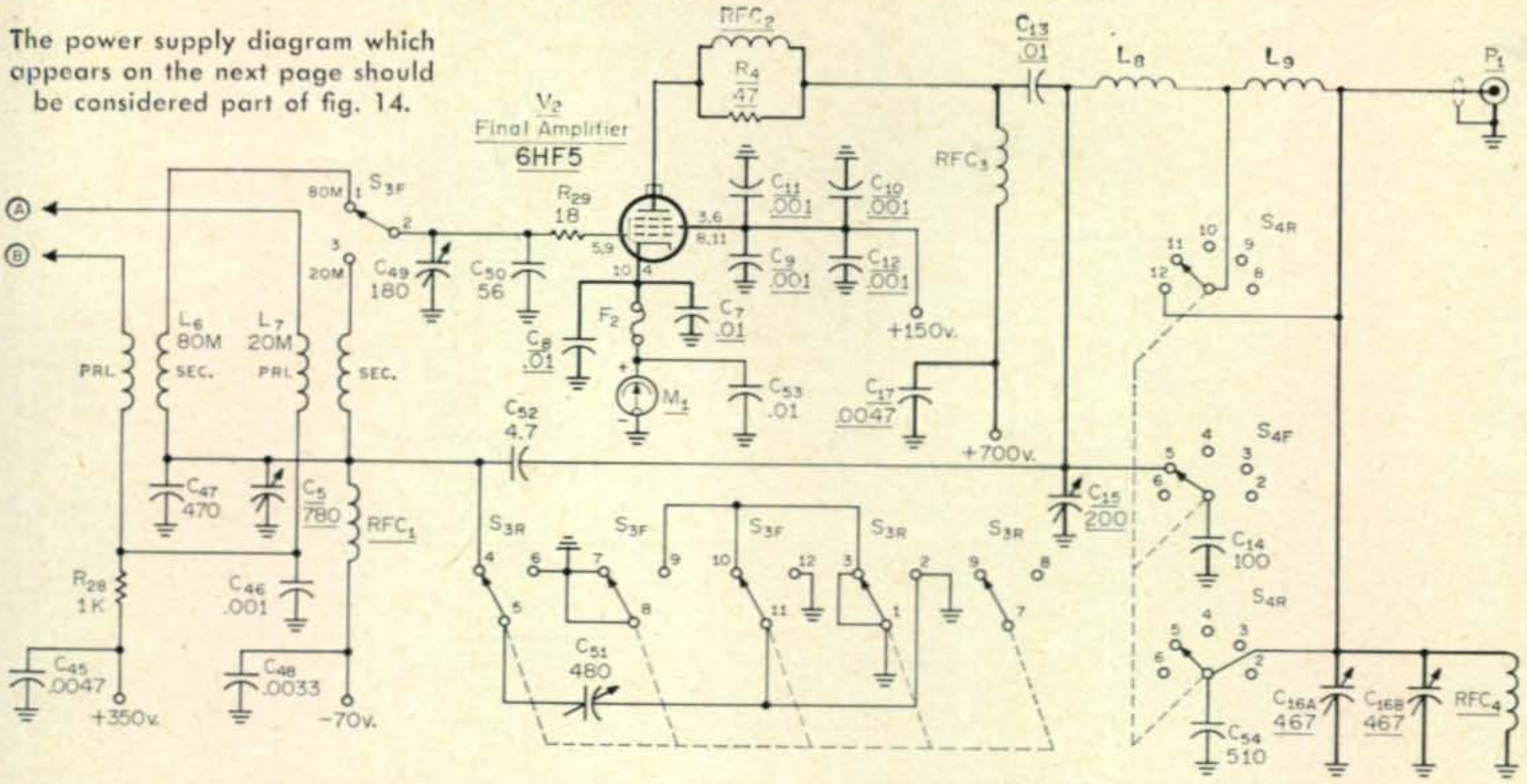


Fig. 13—Close-up view of the driver and final amplifier stages.

The power supply diagram which appears on the next page should be considered part of fig. 14.



Crystal Oscillator

Ground pins 6 and 8 of the loktal crystal socket. Pins 1 and 3 may be used as tie points to support RFC_5 and C_{28}. A wire from pin 2 goes to the grid of V_4. Pin 5 of the 6JH8 is not only connected to one side of the heater, but also, internally, to a shield and the focus electrodes. Therefore, be absolutely certain that pin 5 is the heater connection which you ground.

After the oscillator is finished, plug in V_3 and V_4. V_1 and V_2 should not be in their sockets at this time. Turn on the power and, when the 6JH8 is hot, close S_1. If the oscillator is working correctly, you will hear its strong, steady signal on a receiver tuned to 9.0015 mc.

V.F.O.

Most of the v.f.o. components are housed in a 6" × 5" × 4" utility cabinet. After drilling holes for C_{29}, which is centered both horizontally and vertically on the front panel, spray the back and side of the cabinet adjacent to V_5 with aluminum paint to reflect heat radiated by the tubes.

Since both C_{29} and C_{49}, as originally manufactured, have more capacity than is required for the CQ-150, don't mount them until you have removed 10 rotor plates from each one. Starting at the rear, bend the plates backward, one at a time, and then carefully extract them with long nosed pliers. Since the plates are only pressed into the shaft, they will come out easily. Break off the excess bakelite spacer which previously separated the unused plates. Mount the capacitors with 6-32 screws which have been cut or filed to a length of ⅛".

The v.f.o. pointer visible in fig. 11 was cut from a small polystyrene refrigerator dish and cemented with epoxy to the inside rim of the knob.

Follow the parts layout of fig. 16 as closely as possible. All leads more than a half inch long should be of #12 solid wire. The leads from pins 8 and and 11 of V_5 pass through separate ⅜" ungrommeted holes and terminate at a two terminal tie strip near the rear of the v.f.o. compartment.

Even though you can save more than a dollar by winding L_3, yourself, on a section of ¾" polystyrene tubing, oscillator stability will be enhanced if you purchase the commercially produced ceramic coil specified in the Parts List. Cement it to the chassis with epoxy. Clip off the leads supplied with L_3 and make all connections to the lugs at each end of the coil.

Capacitors C_{32} and C_{33} each consist of four zero temperature coefficient (NPO) ceramic discs connected in parallel. The leads of two 220 mmf units (Sprague 10TCC-T22) and two 270 mmf units (Sprague 10TCC-T27) are twisted together to form the equivalent of a 980 mmf capacitor. Stiffen the twisted leads by thoroughly impregnating them with molten solder.

Solder the ground ends of C_{30} and C_{31} directly to the frame of C_{29}.

Upon completion of the v.f.o., check it out by plugging in the 6J11 and applying power. Listen at 5 mc for the rather faint v.f.o. signal as you tune C_{29} through its range. An insulated wire, looped around the envelope of V_5 and then run to the receiver's antenna terminal, will help you hear the v.f.o. If no oscillation is present, increase the capacity of C_{34} to 75 or 100 mmf. Reducing the resistance of R_{19} and R_{21} a little will also help. However, any of these changes will adversely affect oscillator stability and so you should stick as closely as possible to the specified values.

Mixer

Figure 18 identifies the terminals of S_3 and S_4 as they appear when viewed from the rear with the chassis inverted. In the schematic, S_{3F} refers to the front deck of the switch, while S_{3R} refers to the rear deck. Although S_4 has only a single deck, six terminals are mounted on the front of the wafer and twelve on the rear. Thus, the subscripts F and R also apply to this component.

Close examination of fig. 14 will reveal that S_3 is hooked up in a rather peculiar manner. Many terminals are merely connected to one another and then to ground. The purpose of this weird arrangement is to reduce capacitive coupling between the grid and plate circuits of V_1. Before mounting the switch, make as many of the terminal interconnections as you can. Use short lengths of bare wire and follow the schematic exactly. For example, run separate wires from terminals 9 and 10-S_{3F} to terminal 3-S_{3R}, rather than one wire from 9 to 10 and another from 10 to 3. Electrically, the results will be similar, but, unfortunately, the latter arrangement will produce less shielding. The ground on terminal 6-S_{3R} is provided by a nearby solder lug bolted to the chassis. Terminal 1-S_{3R} is grounded by the tin shield visible in fig. 13 which is soldered in place during driver stage construction.

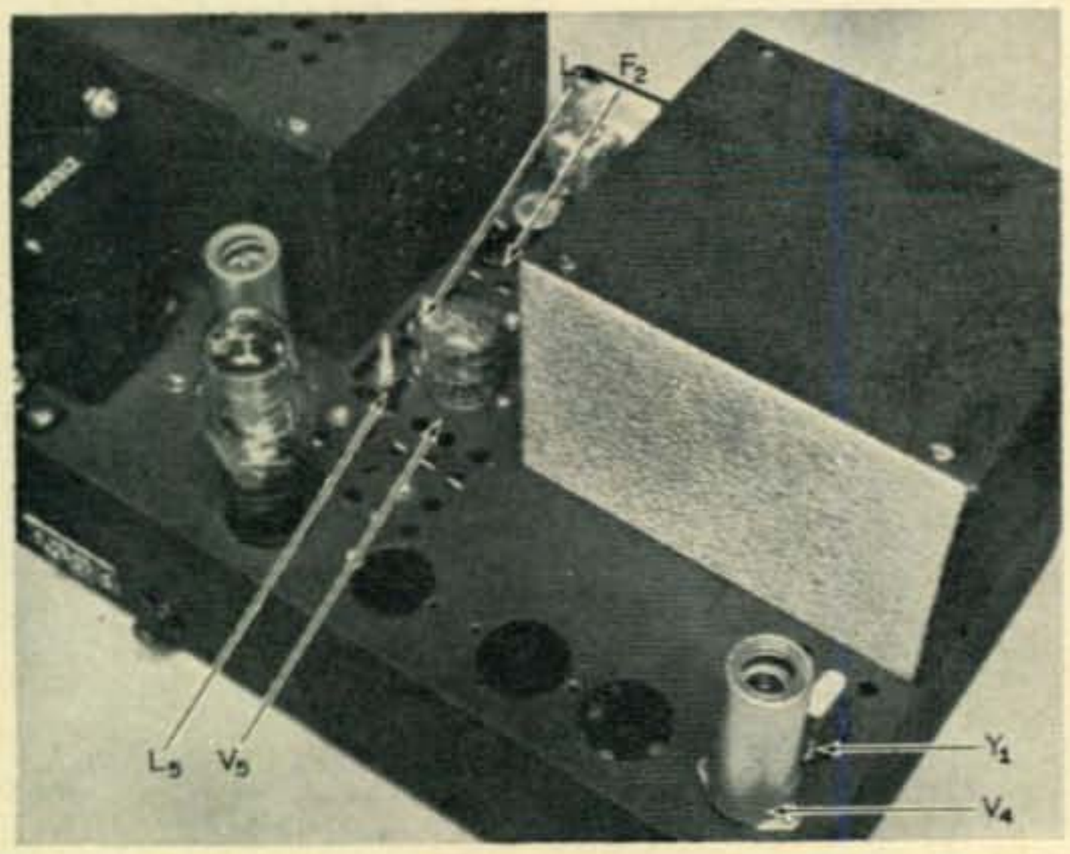


Fig. 15—Rear view of the CQ-150. Note the aluminum coating on the rear of the v.f.o. compartment. A like coating is placed on the side facing V_5 and the meter.

Mount S_3 on a small bracket bent from a piece of sheet metal. Locate the switch so that its indexing plate is exactly 2⅝" from the front of the chassis. Due to its recessed location, an extension and coupler must be added to the shaft of the switch.

Make sure that you ground the terminal of C_{37} which is attached to the movable plate under the adjusting screw. This same procedure also holds true for C_5 and C_{51}.

When all components associated with V_{5R} have been wired in place, open up C_{37}, throw S_3 to the 80 meter position, apply power and listen at 3.7 mc as C_{29} is tuned. At some setting of the v.f.o. knob, you'll hear the output of the mixer. Adjust the slug of L_4 until the signal is loudest. Switch S_3 to the 14 mc band and tune your receiver to 14.3 mc. Readjust C_{29} until you hear the mixer signal again. Peak L_5 for maximum output.

Driver

The balance of the wires going to S_3 may now be connected. Cement a short wooden plug in the end of L_6 to supply material for a mounting screw to bite into. Use epoxy to attach L_7 to the rear of C_{49}'s frame. A two lug tie strip, bolted to L_6's form, below the coil, supports RFC_1 and the ungrounded ends of C_5, C_{47} and C_{48}. The

opposite ends of C_5 and C_{47} go to a lug previously soldered to the frame of C_{49}, while the ground ends of C_{48} and C_{50} go directly to the frame. Ground the center post of V_1's socket.

A 2½" × 3½" shield, visible in figs. 12 and 13, runs straight back from the rear of S_3, bisects V_1's socket and ends an inch from the rear of the chassis. Cut the shield from the wall of a vacuum style coffee can. Provide a notch to clear fuse F_1 and ears for soldering the shield to terminal 1-S_{3R}, the ground lug near terminal 6-S_{3R} and the center post of V_1's socket.

To test the driver, plug in the 12BY7A and key. Switch to 80 meters, apply power and listen for the signal in the receiver. When you've found it, depress the key. The signal should increase. It will become even stronger when C_{49} is resonated. Make a similar test after switching both S_3 and the receiver to 14 mc.

Final Amplifier

Connect a short jumper between pins 4 and 10 of V_2. Cut both leads of C_{52} to a length of ½". Connect one lead to the stator terminal of C_{15} nearest V_2. Solder a piece of insulated hookup wire to the other lead of C_{52} and run it, as directly as possible, through a grommet near the front of the chassis to the junction of RFC_1 and C_{47}. This is the same grommet through which the high voltage lead passes on its way from C_{22} to RFC_3. The ground terminal of C_{51} is soldered directly to terminal 2-S_{3R}. If you carefully compare the schematic with the photos, you should have little difficulty completing the balance of the wiring.

Alignment And Neutralization

Plug in V_2. Connect a dummy load to J_1. Set S_3 and S_4 to 14 mc and tune your receiver to 14.050 mc. Set C_{16} at maximum capacity. After a one minute warmup, flip S_1 up. Tune C_{29} until you hear the v.f.o. signal. Adjust L_5 for maximum receiver response. Press the key and tune C_{49} for the highest reading on M_1. Dip the final with C_{15}. Advance C_{16} until the r.f. indicator shows a high reading or bulb shows an appreciable amount of light. Redip the final. If maximum output does not coincide with minimum cathode

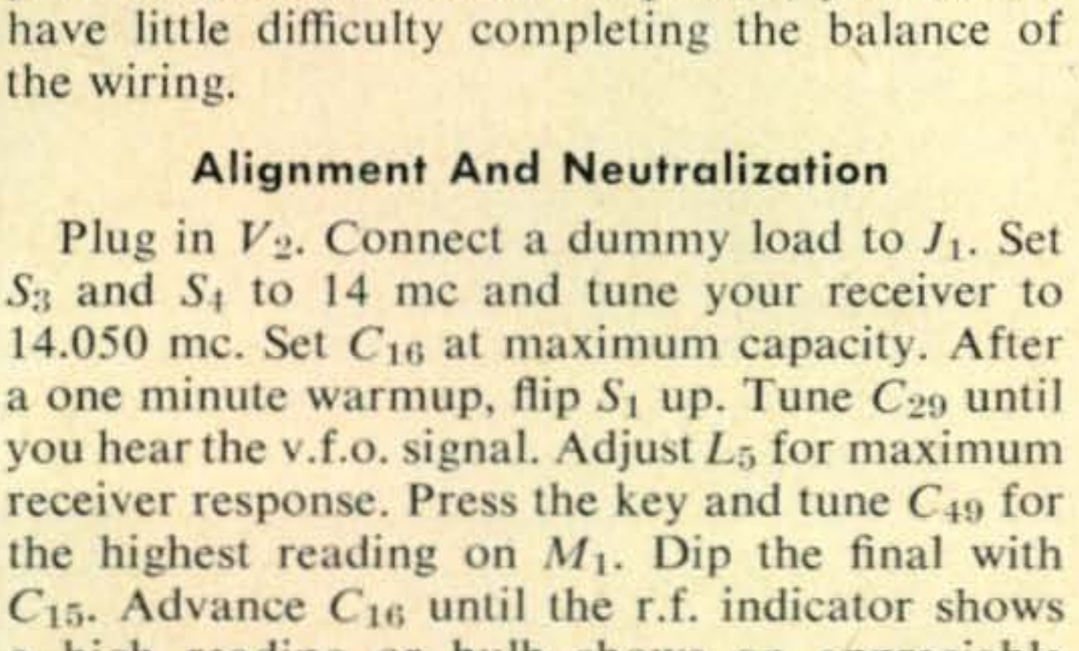


Fig. 16—Interior view of the v.f.o. compartment.

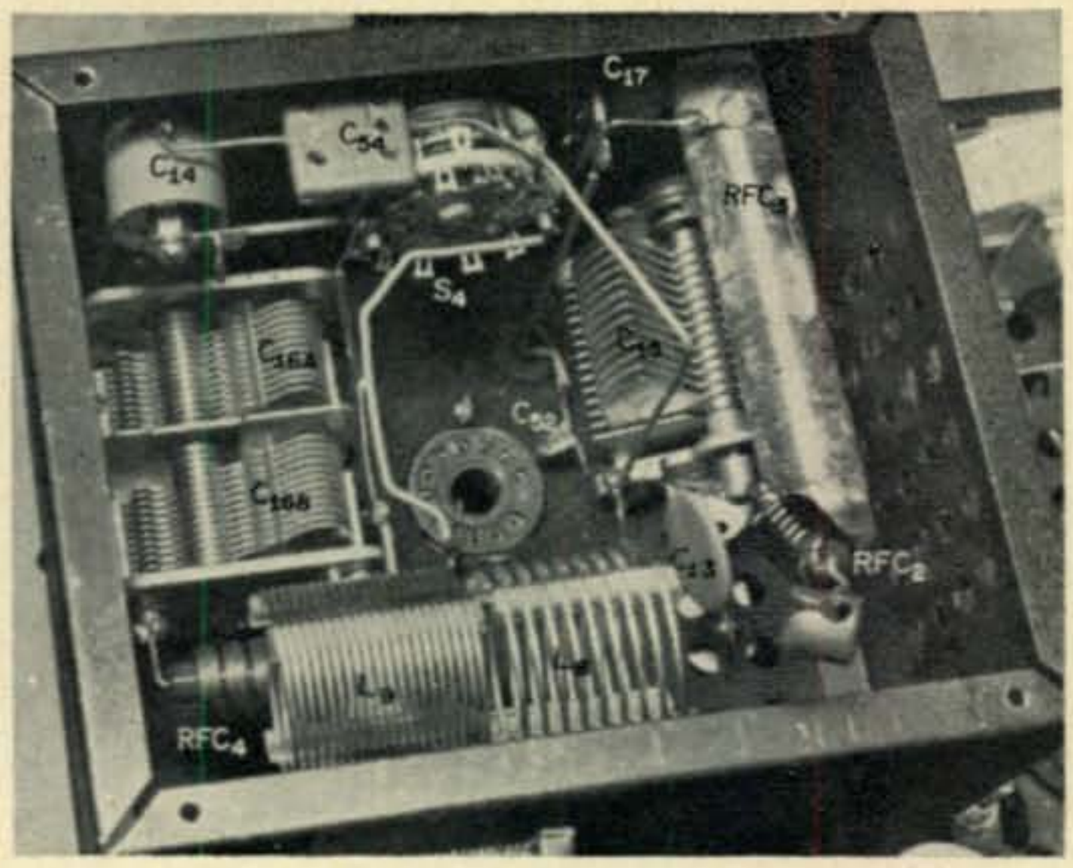


Fig. 17—Interior view of the final amplifier compartment with the cover and V_2 removed.

current, the amplifier is not neutralized. Adjust C_5, a little at a time, while tuning C_{15} back and forth, until the output is greatest at the cathode current dip.

Load the final to full output. Adjust the slug in L_5 to produce maximum output as shown by the r.f. indicator or lamp brightness. Slowly increase the capacity of C_{37} until the output reduces by a barely perceptible amount, thus indicating optimum drive to the mixer grid. Meter M_1 should now read approximately 220 ma, the normal operating level.

Switch the rig to 80 meters and the receiver to 3.6 mc. Tune the v.f.o. and L_4 for maximum receiver response. Tune C_{49} for maximum cathode current. Dip the final with C_{15} and load it with C_{16}. If maximum output does not occur at the dip, touch up the neutralization with C_{51}.

Warning

Components T_1 and V_2 will perform long and well under regular c.w. conditions where they can rest between dots, dashes, letters, words and during standby intervals. However, neither the transformer nor tube will survive extended periods

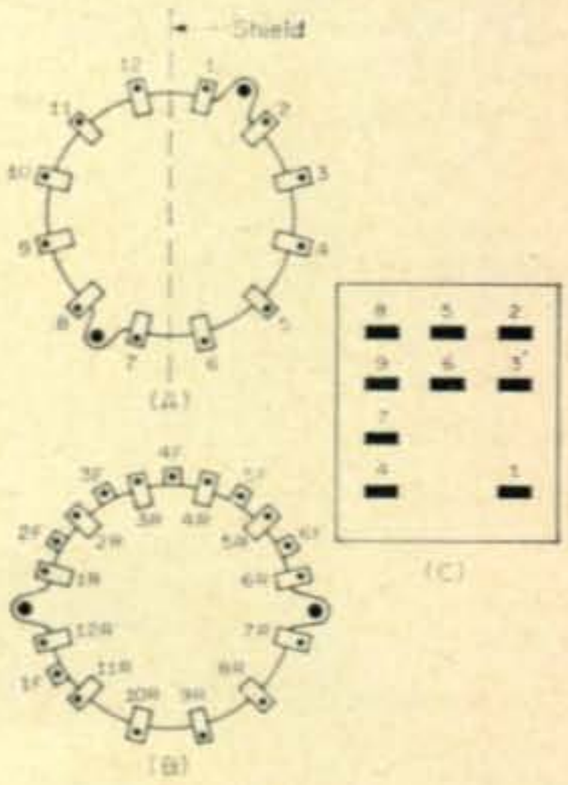


Fig. 18 (A)—Rear view of one S_3 wafer as seen with the chassis inverted. The shield bisects the switch at the angle shown. (B) Rear view of S_4 as seen with the chassis inverted. Subscript *F* represents front terminals and subscript *R* represents Rear Terminals. (C) Terminal identification of relay K_1.

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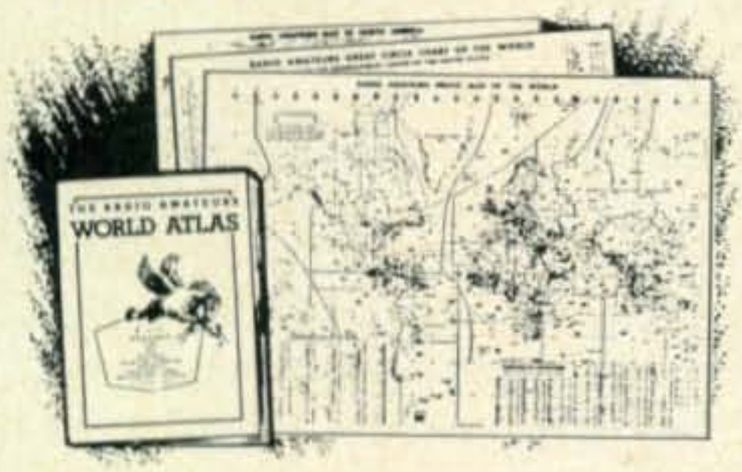

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of key down operation at the 150 watt level. Consequently, *never* leave the key depressed more than 10 seconds at a time! Allow the tube to cool at least 30 seconds before pushing the key again. If, at the end of 15 minutes, you haven't concluded initial adjustments, shut down the rig completely for a half hour before resuming tests.

With S_1 or S_2 closed, and the key up, 900 volts (!) appears at the top of C_{22} and on the plate cap of V_2. When first checking out the transmitter, exercise *extreme caution*. Keep your fingers away from the rig's innards, whenever the power is on. *Do not* touch any component until the a.c. cord is out of the wall plug and C_{22} has been discharged to ground with an insulated shorting prod. Paste a "HIGH VOLTAGE" warning notice in a prominent spot inside the chassis where it will serve a sa safety reminder. All coverplates should be bolted firmly in place during normal operation.

V.F.O. Alignment

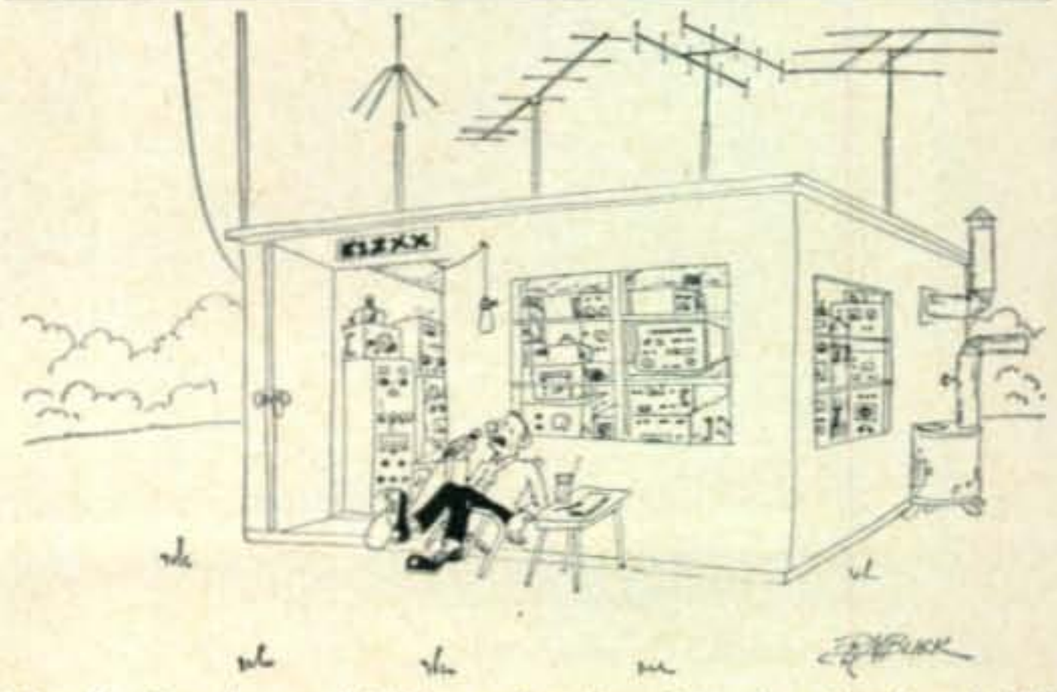
On 14 mc, C_{29} works in the conventional fashion. That is, the greater its capacity, the lower the frequency. However, due to the mixing process, the 80 meter band is inverted. Thus, 3.5 mc is obtained when the capacitor is almost wide open, while 4 mc output occurs when it approaches full capacity. If, because of variations in component values, you discover that one end of the band can't quite be reached, replace C_{30} with an NPO capacitor having a slightly different value. Use less capacity if C_{29} won't hit 3.5 mc, even when wide open or more capacity if 4 mc is off the end of the dial with C_{29} fully meshed. Don't worry about the 14 mc band. Once you have 4 mc under control, the higher frequency band will take care of itself.

You're now ready to calibrate the v.f.o. against an accurate receiver. Draw a dial, preferably with India ink, and cement it to the front panel of the v.f.o. compartment.

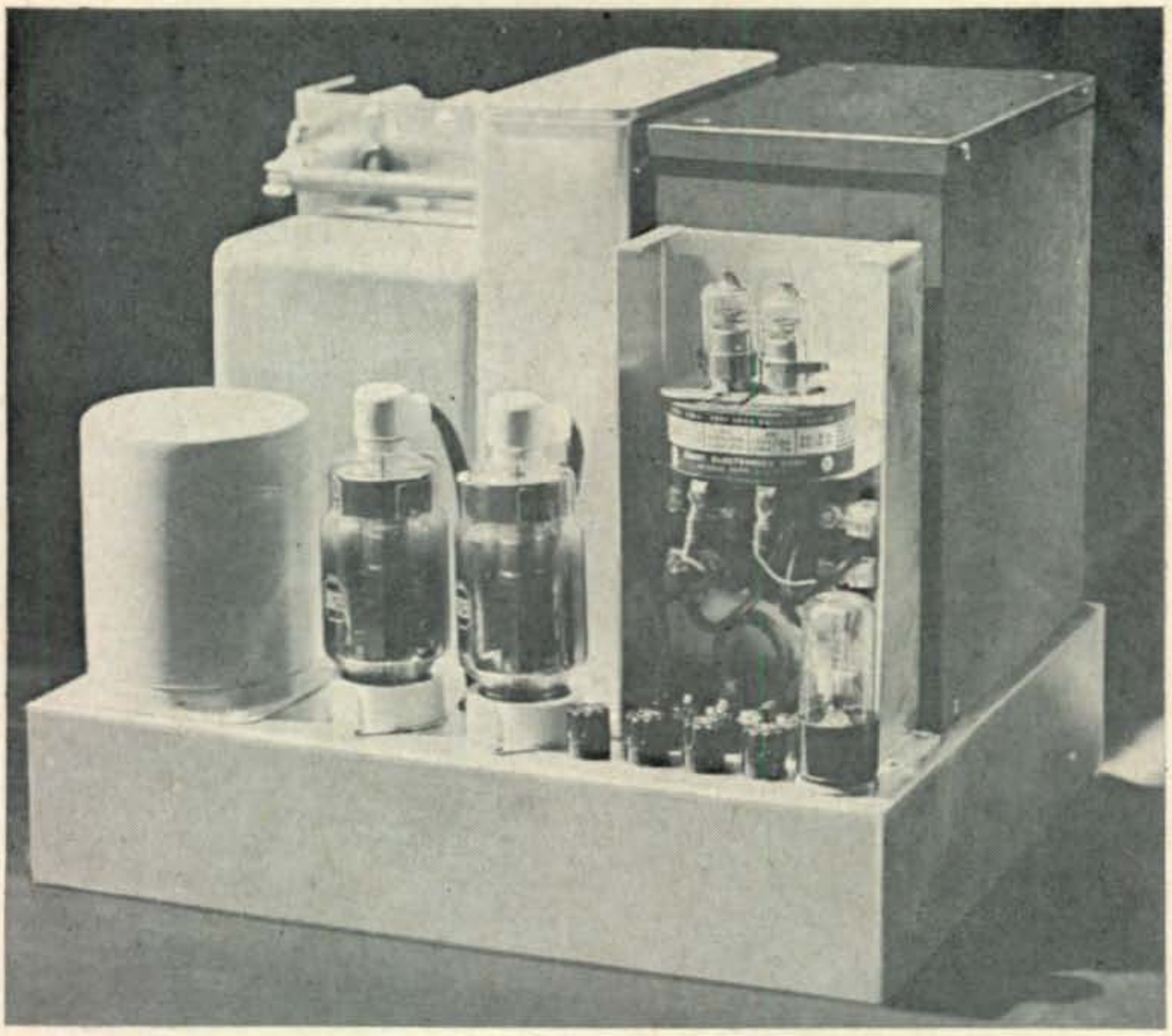
Antennas

A simple dipole will prove satisfactory for 80 meters. However, for serious 20 meter work, you must use a beam antenna mounted 50 to 60 feet in the air. Although verticals and dipoles will give fair results at medium distances on 20, either a 2 element Quad or a 3 element Yagi are musts if you want to consistently span the oceans.

[*To be continued*]



"Yeah, I've been thinking of enlarging the shack a bit!"



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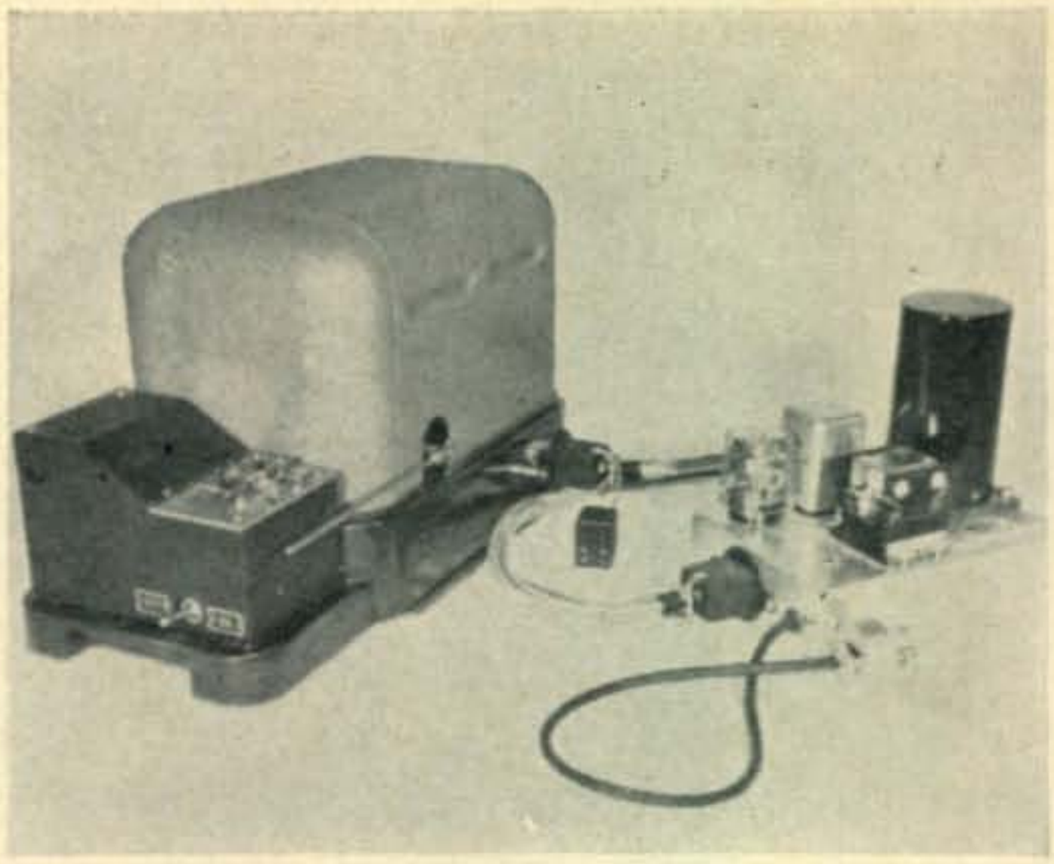
For further information, check number 9, on page 110

Dual Identification From Your Tape Distributor

BY JAMES L. McCOY*, WØLQV



The complete system for automatic dual identification. The twelve pole relay, K_3, is in the foreground on the chassis at the right. The other relays are K_2, K_1 and K_4 in that order (l to r). The shorting Jones plug is attached to the cable connector by a small ball chain. D. c. power is picked up by the three pronged crow-foot plug.

With the FCC modifying but still continuing the requirement of dual identification for the transmitting station when using radioteletype, this writer thought it might be well to take another look at an idea first advanced by W2BFD. The system provides Continental Morse (shift keying) along with regular radioteletype transmissions all produced from tape perforated with standard coding from the keyboard or reperforator. Circuitry also includes automatic switching from one mode to the other triggered by the use of specific pulses from the tape.

The equipment used in this case is the Model 14 transmitter-distributor upon which considerable circuit modification is necessary along with the addition of four relays and other components.

The normal operation of the TD is to detect tape perforations and produce properly sequenced electrical pulses from a commutator type rotary distributor. The problem involved is to use the same distributor to transmit Morse code also detected from perforated tape.

Circuit Operation

Two conditions of circuitry exist in the system. One condition is developed when relays K_1, K_2, and K_3 are not energized. Here tape contact number one is connected through one coil of polar relay K_4 to segment number one of the distributor and tape contact number five is connected through the other coil of K_4 to segment number five. Relay K_4 will now move in one direction (close) when channel one is energized from the tape and in the other direction (open) when channel five is energized.

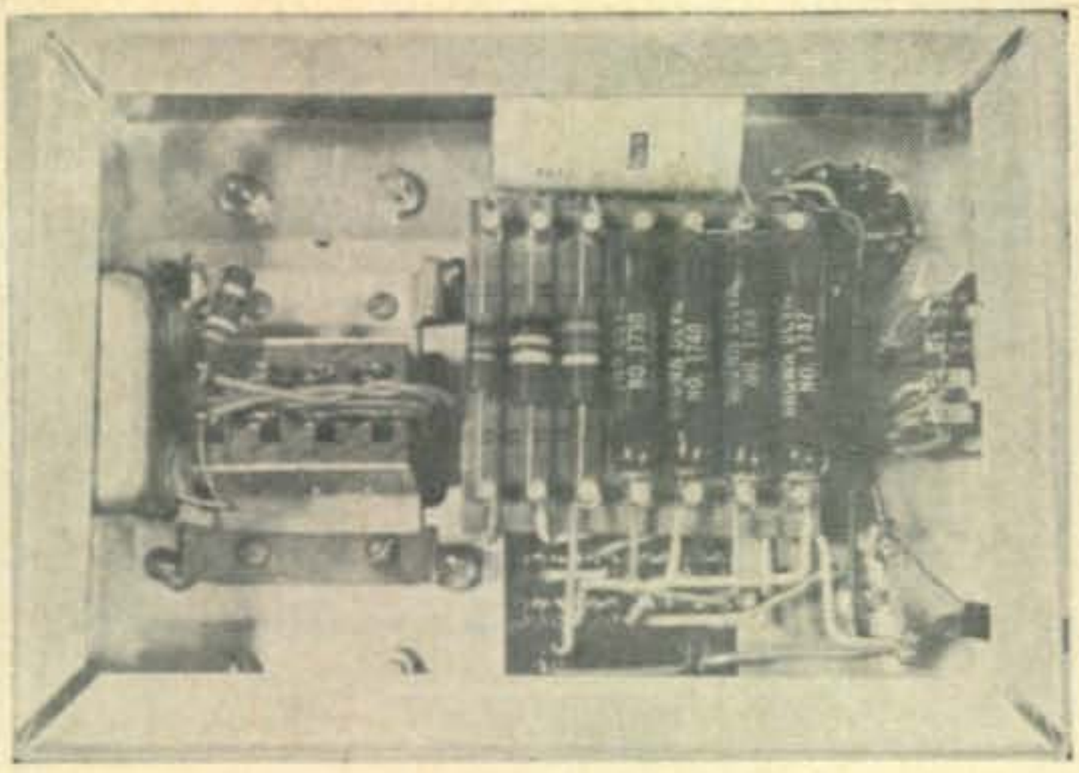
To produce the desired Morse code the proper characters must be punched into the tape to energize channels one and five in a manner that will create dots and dashes in a time ratio of 1 to 3.

It will be noted from standard teletype coding the letter "E" is produced from a pulse from channel one only, the letter "T" from channel five only and the letter "Z" from channels one and five. If a tape punched with the letter "Z" is passed through the transmitter-distributor the polar relay will close when the armature passes over segment one. The relay will remain closed until the armature contacts segment five and will then open. The keyed circuit is thus closed for 0.088 seconds. If the tape is punched with the letters "E" and "T" in succession the armature will close the polar relay at segment one. The relay will remain closed during the remainder of the revolution. At this point the tape will advance to the letter "T" and the relay will open on segment five producing a keying period of 0.251 seconds and very close to three times the previous period. Using the letter "Z" for dots and the letters "E" and "T" in succession for dashes with a single blank between characters and two blanks between words, a code speed of approximately 15 w.p.m. will develop.

To transfer the system to teletype coding, relays K_1, K_2 and K_3 are energized in sequence. The change is initiated by punching into the tape any character containing a channel two perforation (we use the LTR punch). A pulse from segment number two closes K_1 and the sequence is started, each relay closing the next. As soon as K_3 is closed all distributor armature pulses will pass through R_1, the voltage across which will intermittently operate K_1 keeping the delay circuit of K_2 charged holding K_2 and K_3 closed. As long as perforated tape is passing through the TD the system will hold in the teletype condition.

All that is necessary to return to Morse code is to de-energize K_1 long enough to allow K_2 to open and release K_3. In our case the time delay was approximately two seconds requiring twelve blanks in the tape before beginning code perforations.

*8319 Marty, Overland Park, Kansas 66212.



Bottom view of the relay chassis shows the component terminal board on the right and the polar relay socket on the left with spark suppression circuit R_8 and C_2 connected.

For the conservative type who have a limited amount of tape on hand, a switch can be used to transfer distributor segments one and five to tape contacts three and four. Using the letter "N" for dots and SPACE and CARRIAGE RETURN in succession for dashes, Morse code tape with punches one and five can be repunched with three and four.

An additional bit of automation can be had from another set of contacts on K_2 to transfer K_4 keying directly to the exciter for A1 identification.

Construction

The unit is constructed on a 7×5×2 inch chassis which provides adequate room for all components. The selection of relays K_1, K_2 and K_3 is not critical. Relay K_1 must close on the voltage drop across R_1 (20 to 30 volts) and operate fairly rapidly. Relay K_2 should be a high resistance type to minimize the required size of C_1 in the time delay circuit. The value of C_1 may be anything that will produce a convenient time delay for K_2. Relay K_3 may present more of a problem. The relay used was 12 pole double throw IBM computer type with a 40 volt coil. Multiple contact telephone type relays may be more readily available or more than one relay can be used to arrive at the necessary eleven poles. The value of R_2 must be adjusted to meet the voltage requirements of the relay(s) used.

Resisters R_1 through R_7 and C_1 are terminal board mounted and suspended below the relay sockets. Components R_8 and C_2 form the spark suppression circuit for K_4 and are mounted directly at the socket.

Installation

A Jones 12 pin 300 series connector is mounted on the side of the transmitter-distributor where there is usually found a ⅜ inch hole flanked by two number 6 threaded holes. The ⅜ inch hole is convenient for passing wire out to the connector which is mounted on stand-offs at the threaded holes. This eliminates any necessity for cutting additional holes in the TD.

A twelve wire vinyl covered cable connects the TD to the relay unit which is located on the power supply shelf of the Model 19 table. The cable also contains a pair from the contacts of the polar relay to the keying connections of the TD so as not to disturb the interchangeability of other unconverted TDs.

If it is desired to by-pass the automatic system, a shorted Jones plug can be used to replace the cable. ■

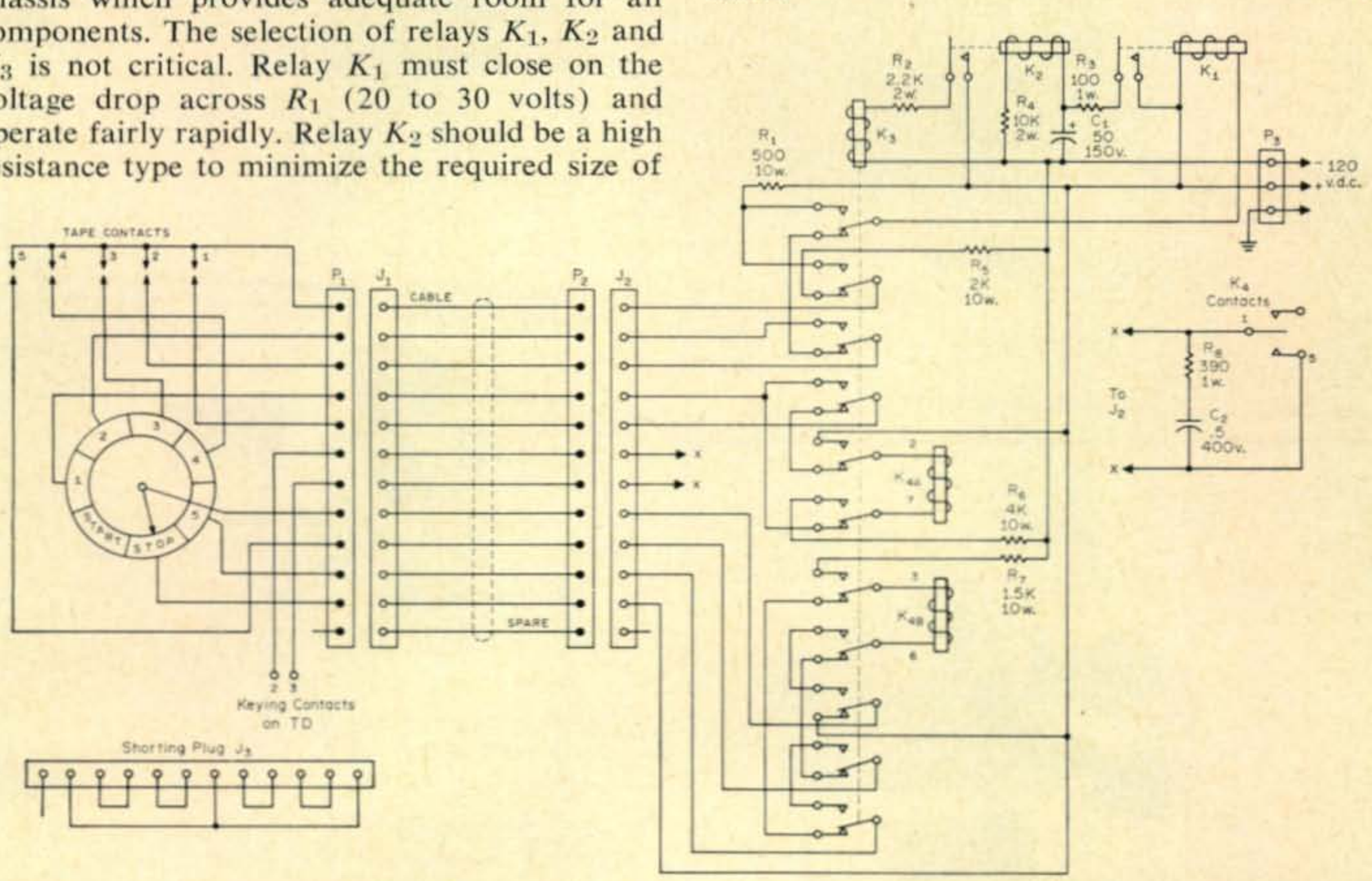
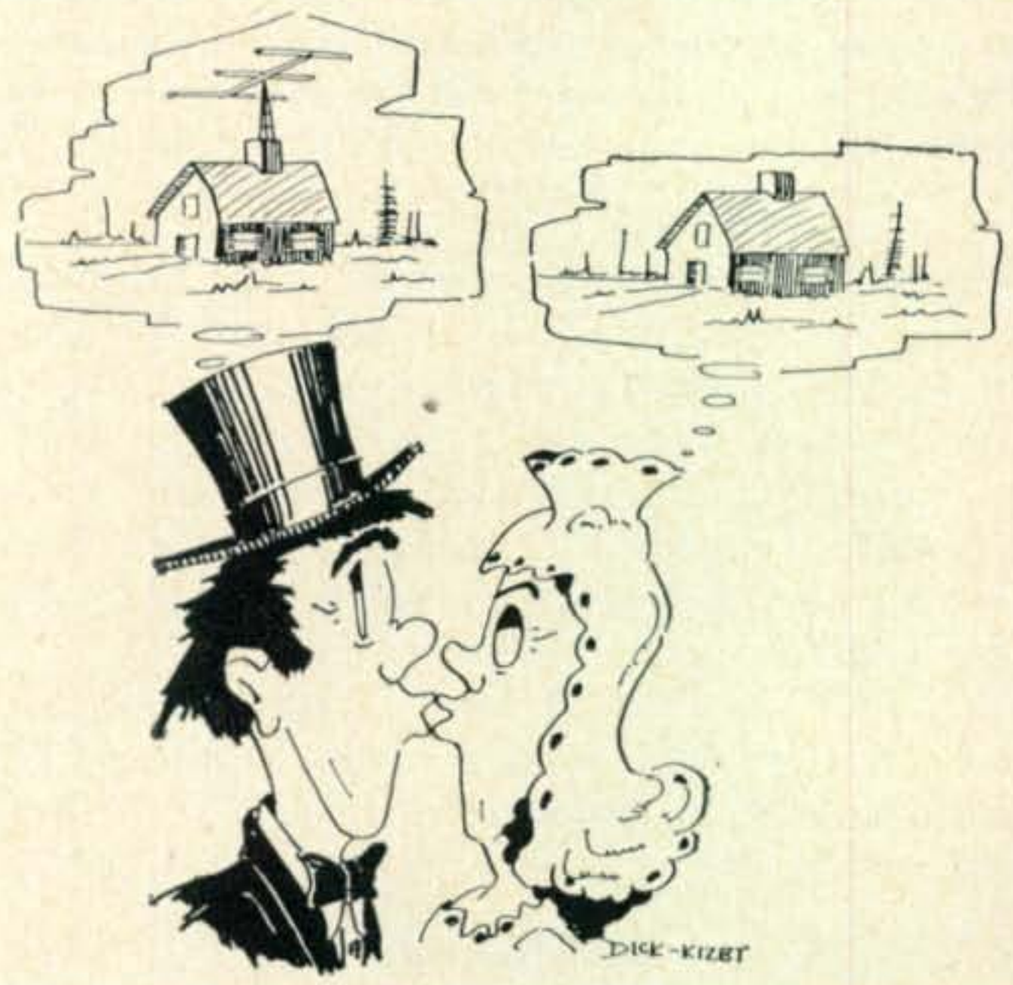


Fig. 1—Circuit of the relay system and modifications needed on the Model 14 TD for c.w. and regular teletype operation from a single tape.

K_1—S.p.s.t. m/o relay, 1K coil. Sigma 5R1000 S/SIL or equiv.
K_2—D.p.d.t. (one pair only used) 2.5K coil, Potter & Brumfield KCP 11 or equiv.
K_3—12 p.d.t. relay—See text.
K_4—Polar rely. WE 255.

Clever Quips!



"Too much feedback!"

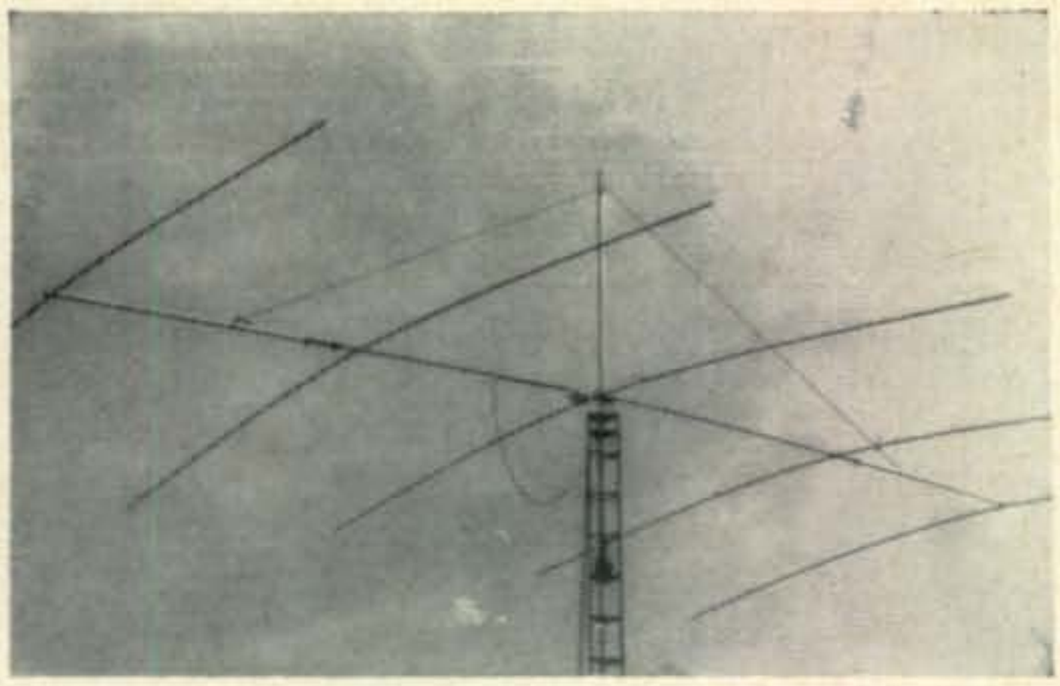
"At one time this rig used to take off."

"NW OM PSE Advise if still chirp HR."

"Don't worry; you'll pass tomorrow—they'll know a ham when they see one."

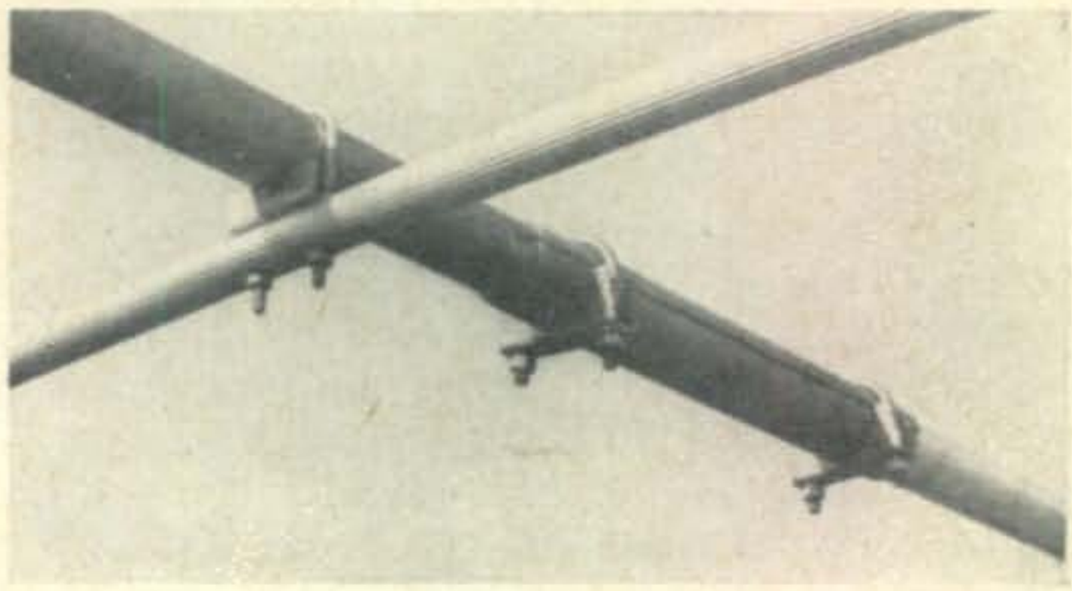
A REMOTELY TUNED 5 ELEMENT 20 METER YAGI

BY RONALD LUMACHI,* WB2CQM

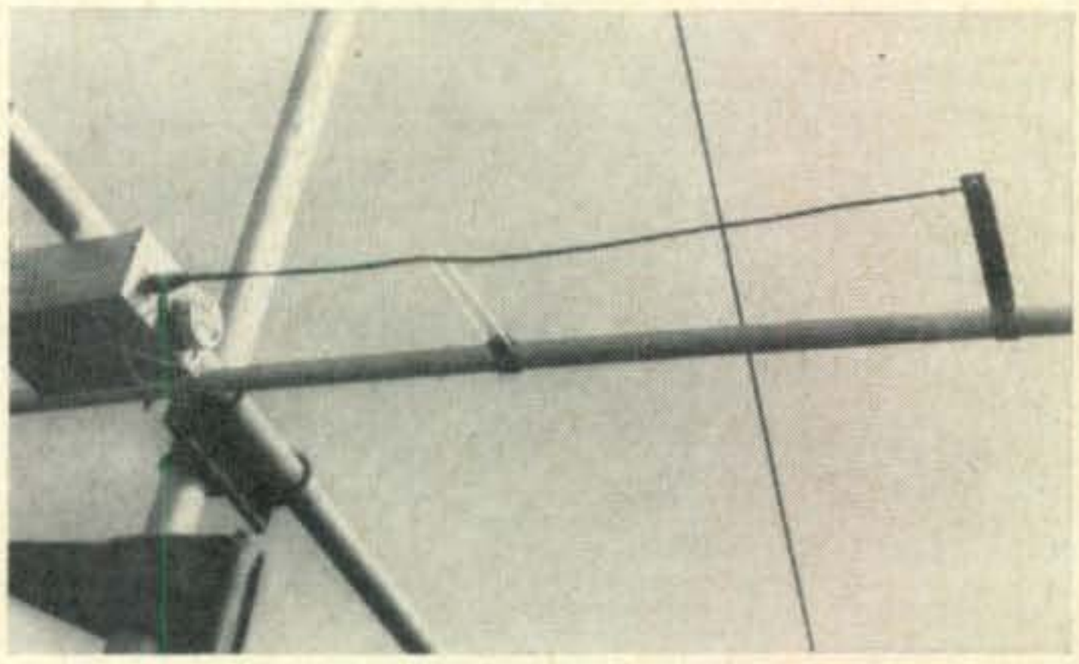


The completed antenna mounted on a tower.

AMONG the various antenna systems available to the amateur, the yagi configuration apparently endures despite all competition. The rather high gain factor, good spurious attenuation characteristics, ease of construction and final tuning add to its qualities. The following text describes the construction of such a yagi array. It includes the employment of a remotely tuned system for fine tuning at the transmitter with the antenna at the normal operating height.



View of the clamping method for extending the boom length and the mounting method for the elements.



View of the gamma match system.

Interior view of the Minibox housing the gamma match capacitor and the drive motor.

General Description

The antenna is a 5 element yagi (36′ boom) boasting approximately a 9 db gain over the dipole standard of comparison. For a higher front-to-back ratio, two reflectors are placed behind the driven element to assist in reducing the noise level to the rear. The entire element system is made from standard 12′ telescoping lengths of aluminum tubing and adjusted to the resonant lengths. For those with no need for the 5 element version of this array, simply delete the details dealing with the addition of the first director and second reflector (and boom extensions) and treat the system as a 3 element yagi (20′ boom). As a result, only a degree of gain and front-to-back ratio will suffer. For other than those extreme "pile up" situations, the smaller version will perform more than adequately.

Element Construction

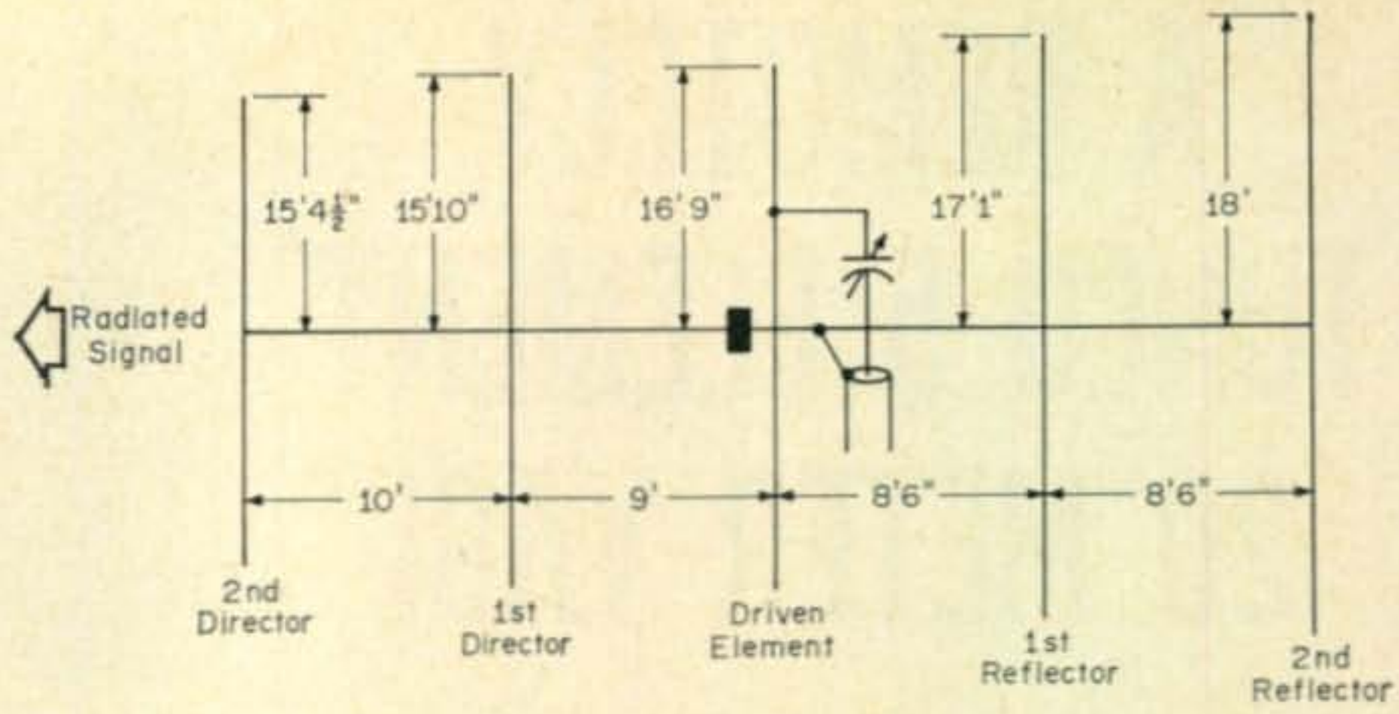
The 5 (or 3) elements are all built exactly the same using 12′ lengths of 1″ and ⅞″ telescoping tubing. The individual elements are adjusted to conform to the measurements in fig. 1.

Be sure that the outside diameter of the smaller tubing will slide into the larger unit with an absolute minimum tolerance. This feature will insure a well constructed beam and will guarantee a good inter-element mechanical and electrical bond. A complete tubing kit is available from Gotham Inc., Miami, Florida at a reasonable price. The 3-QM and the 5-QM kits (for the 3 and 5 element antenna versions include the necessary material to construct the aluminum radiating elements; however, in the 5 element version, an extra 3′ length of ¾″ tubing is necessary in order to satisfy the additional length requirement of the second reflector. Local hardware stores, featuring the Reynolds Metal display, stock this diameter material at a cost of less than a dollar.

Each element should be carefully measured for overall length insuring that each of the ⅞″ diameter lengths is telescoped an equal distance into the larger unit for balance.

*73 Bay 26th Street, Brooklyn, New York 11214.

Fig. 1—Element and boom dimensions for the 5 element 20 meter yagi antenna.



Once the lengths are determined, drill each telescoped intersection for two stainless steel self-tapping screws. Conductivity and rigidity are of equal importance and are adequately provided for with the screw insertions. Test for element balance by lifting the individual units at its center.

Each radiator is placed perpendicular to the plane of the boom and fastened using the common TV "U" clamp. Drill two ¼" holes equidistant from the element center in order to fasten the clamp. Mount each element according to the dimensions of fig. 1, bearing in mind that in the 3 or 5 element version, the driven element is placed as close to the center of the boom as possible. Since the mast usually intersects at the exact center point of the boom, the driven element should be offset at least several inches. Where possible, place this element on the reflector side of the boom-mast intersection.

For the lesser element version, a boom length of 20' 1¼" I.P.S. (1⅝" o.d.) is required in order to establish a proper spacing and resultant phase relationship.

The 5 element yagi requires an additional boom length of 16'. Two 10' lengths of standard electrician's 1¼" aluminum conduit pipe is purchased and 2' segments are sawed off from each length. One of these shorter (2') units is halved and slit lengthwise thereby providing the builder with four 1' half shells. "Sandwich" over the butted boom and boom extension and secure with two 2" automobile muffler clamps for an adequate mechanical connection. The remaining two elements are installed at the extreme ends of the extensions completing this phase of construction.

Gamma Match

The gamma method of antenna-transmission line matching is especially suitable with the employment of coaxial line. The inherent inductive reactance in this feed method is cancelled by employing a series capacitor along the gamma stub length. Expressed rather simply, the capacitor introduces a value equal in magnitude to the reactance (peculiar to the individual installation) resulting in a cancellation of this power absorbing factor; a pure resistive load results. A variable capacitor is used to adjust for that exact value and a motor driven capacitor is further employed for above ground level manipulations.

Although the gamma match component is the

[*Continued on page 102*]

Parts List

5 lengths 12' aluminum tubing 1" O.D.*
10 lengths 12' aluminum tubing ⅞" O.D.*
20' length 1¼" I.P.S. heavy wall aluminum pipe
2 lengths 10' electrician's conduit pipe 1¼" I.P.S.
5 TV "U" clamps (extra long shanks)
20 stainless steel self tapping screws ½"
1 clamp 1"
1 polystyrene insulator 1x6x¼"
1 polystyrene insulator 4x4x¼" (approx)
1 copper strip 1x12"
1 Minibox (size dependent upon capacitor)
1 porcelain feedthrough insulator
1 SO-239 connector
1 PL-259 connector
1 50" length #10-12 copper wire
2 Clamps 1⅝"
1 synchronous motor 110 v.a.c. 1-2 r.p.m.
1 moderately spaced capacitor (see text) 100mmf, 360 degree rotation.

*Element kit available from Gotham, 1805 Purdy Avenue, Miami Beach, Fla. 33139
$6.00 per element (36') REA exp. coll.

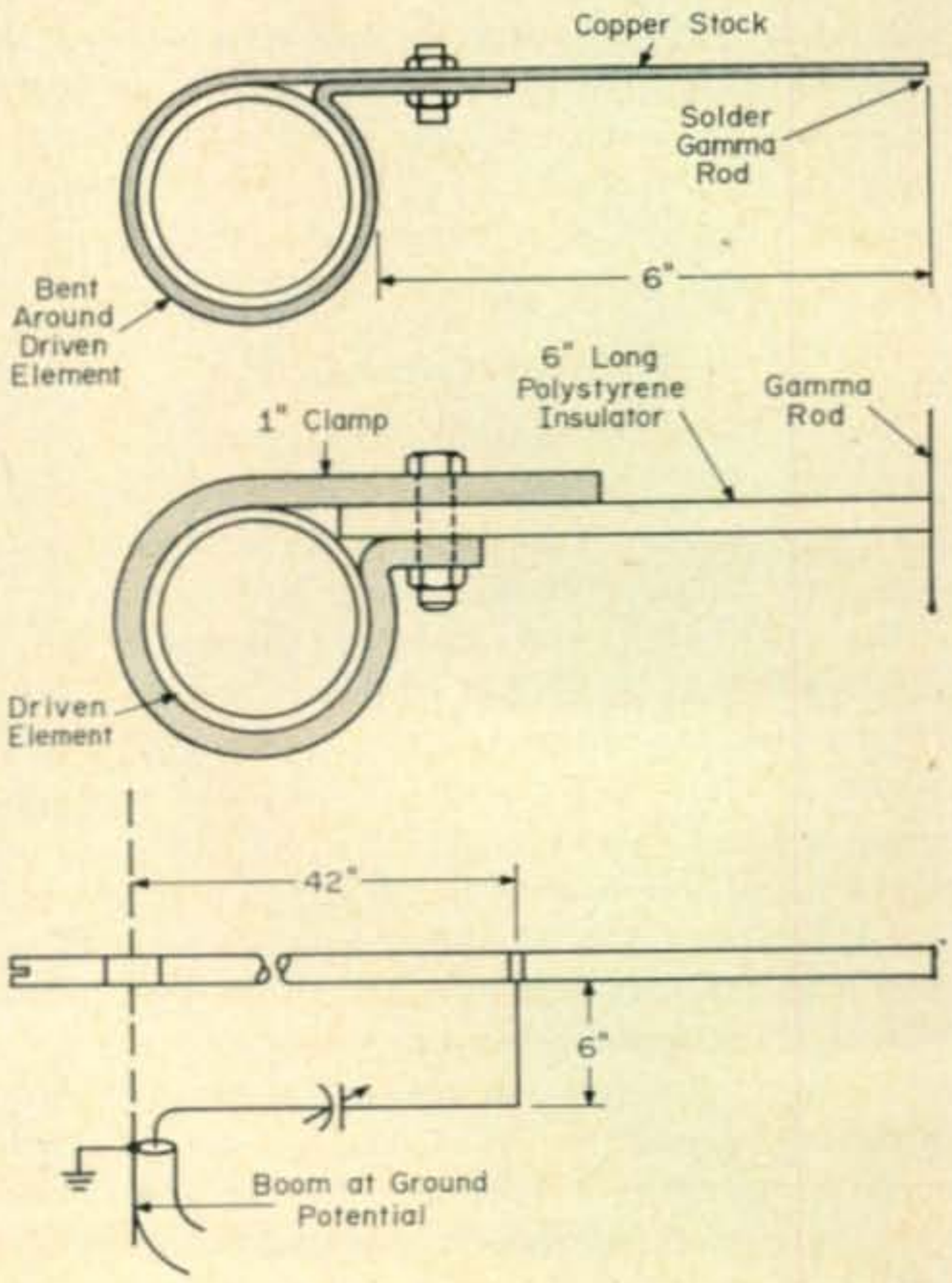


Fig. 2—Gamma match clamp and support details.

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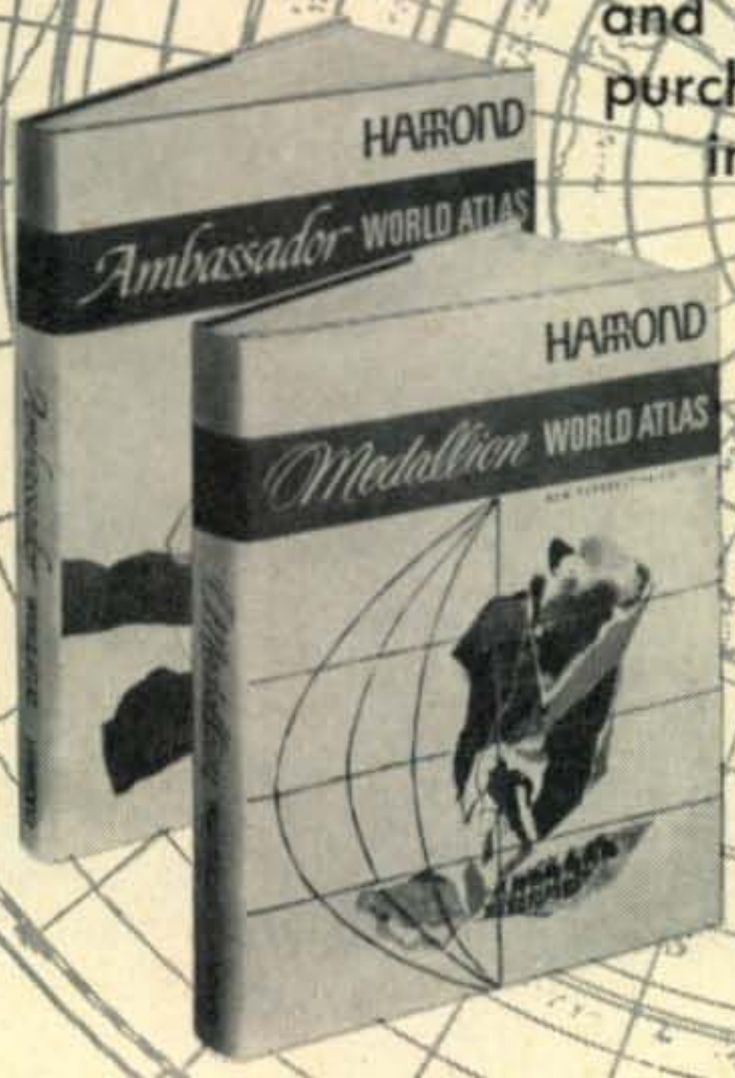

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LOUISA B. SANDO,* W5RZJ

During the Girl Scout International Heritage Camp in the Philippines Jan. 22-Feb. 2, 1966, DU1GSP, Girl Scout Hq. station, was located in this grass hut.

DU1GSP, amateur station of the Girl Scout National Headquarters in the Philippines, is, so far as we have been able to learn, the only such station established by a Girl Scout Hq. Currently the trustee and operator of DU1GSP is Frances Lacebal, who received her license in 1963.

As the only licensed (radio) Girl Scouter in the Philippines, Frances plans the program for DU1GSP in conjunction with national as well as international events, such as the annual Jamboree on the Air sponsored by the Boy Scouts. During the GSP National Encampment in Davao City in May '63 they had a shack at the campsite with DU1GSP/9 as the call.

During the International Heritage Camp held Jan. 22 to Feb. 2, 1966, DU1GSP was in operation at the campsite in a hexagonal grass hut which also housed the information center and intercom set-ups. Frances adds: "The International Heritage Camp was one of the highlights of our Silver Jubilee celebration of Scouting in the Philippines. We had about 200 girls from 8 countries. Via DU1GSP we handled messages of the Scouts through the national civil defense net and the hams. For the foreign contingent we were able to send a message to USA GS Hq. via KR6KS from Virginia Shipley, leader of the U.S. delegation. Mrs. Setzuko Nagashima, of the Japanese delegation, sent a message via JA2VO and JA1SC. Girl Scouts from China, Japan and the U.S. and the local girls enjoyed wonderful QSOs with the hams from KR6, XW8 and KG6 land, and even our national president of GSP exchanged greetings with these hams. We were able to log 29 different countries."

Frances says she has tried putting on a training session where she invited local hams to teach c.w., theory, etc., but found the Philippine girls are not adept at it, especially c.w., so she is trying a different approach by exposing them first, putting them on the air, and hoping they'll get bitten by the bug before she starts formal training. She is working with a group of Senior Scouts she hopes to train to take over operation of DU1GSP.

Frances comments: "I have to see to it that amateur radio becomes a definite fixture of the Girl Scouts in the Philippines and am studying the possibility of inserting it in the Senior program or the badge work of the Juniors. As it is, it is difficult to blaze a trail. But the letters and inquiries we receive like yours from DX hams urge me to push on."

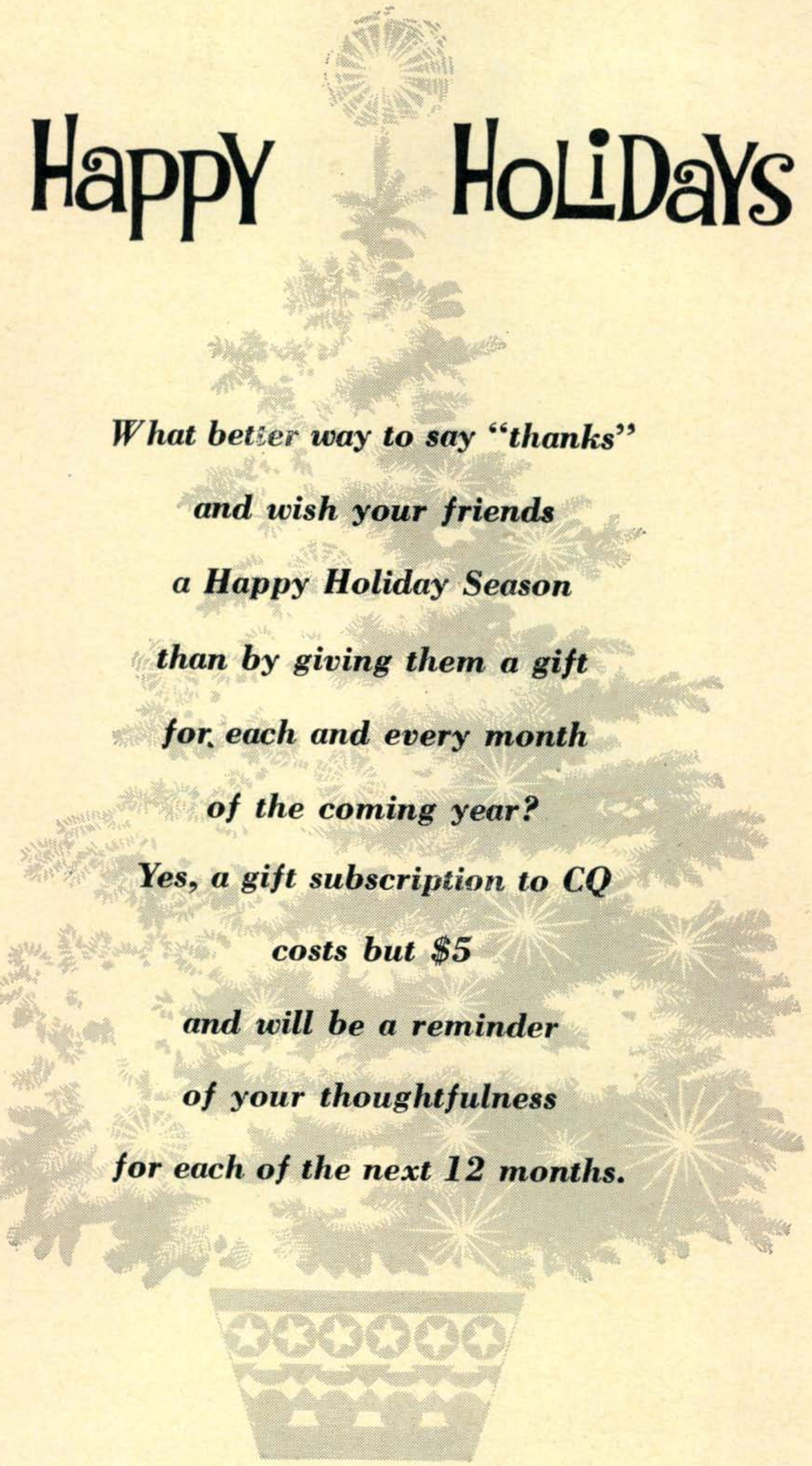
Frances was formerly a Senior Scout troop leader in the Manila Council, as a result of which the troop received an Outstanding Troop Plaque and the Rangers International Recognition Certificate in 1959 (issued by the World Assn. of Girl Guides and Girl Scouts—only the 2nd world award and the first in Asia). Now, in addition to her DU1GSP duties, she is a troop committee member and helps the National Hq. committee on the Senior program and handbook planning.

Frances has a construction permit and hopes to get her own station, DU1FL or DU1YL, on the air, but comments it is difficult to obtain equipment. Time, also, is at a premium. A graduate of the Univ. of the Philippines, with majors in economics and history, Frances has been teaching since 1953, currently at the Manuel A. Roxas High School in Manila. She also teaches

[*Continued on page 104*]

*4417 Eleventh St., N.W., Albuquerque, New Mexico 87107.

Frances Lacebal, trustee and operator of DU1GSP, Philippine Girl Scout Hq. station, in QSO with KR6BD and KR6SR during the Girl Scout International Heritage Camp. Many messages were handled, DX QSOs enjoyed, and 20 countries logged during the encampment.


HAPPY HOLIDAYS
What better way to say "thanks"
and wish your friends
a Happy Holiday Season
than by giving them a gift
for each and every month
of the coming year?
Yes, a gift subscription to CQ
costs but $5
and will be a reminder
of your thoughtfulness
for each of the next 12 months.

DX

BY URB LE JEUNE,* W2DEC

Here and There

EA9 Spanish Morocco: William, EA9EO, is very active from Cueta on the North African coast. He uses 14 mc c.w. and identified by a T8 note. *(Tnx VERON)*

FW8 Wallis Island: FW8RC will be on the air every Sunday from 0700 GMT on 14,240 s.s.b. *(Tnx VERON)*

JY Jordan: Smitty, 601AU, hopes to be signing JY1AU shortly using a tri-band beam. *(Tnx LIDXA)*

MP4 Muscat: MP4MAW has been on 14203 tranceive at 0200 GMT. *(Tnx LIDXA)*

SVØ Dodecanese: Don, SVØWU, reports that he is the only station active now from here. He uses a TR3, courtesy of K5ZCA, and will be here another 1½ years. He was worked on 21404 at 1800 GMT. Don reports that there should be two more stations on from Rhodes soon, and that at present there are no stations active from Crete now that SVØWR is QRT. *(Tnx LIDXA)*

TG8 Guatemala: This rare prefix is available daily. John, TG8CJ, is QRV on 21390 starting at 2345 on 14332 starting at 1900. *(Tnx W2GT)*

TN8 Congo Republic: TN8AA has been very active on 21330-350 at 19-2200 GMT almost daily. *(Tnx LIDXA)*

TY Dahomey: 5N2's AAW and AAX have permission to operate from here and plan to DXpedite mainly on weekends. *(Tnx LIDXA)*

VK New Guinea: VK9TG injured his back and was forced to return to the states. May return to N. G. *(Tnx K6CAA)*

VKØ Macquarie: VKØMI listens for W's and K's at 0500 on Sundays. Transmits on 14,180 a.m. Listens 14,245 s.s.b. *(Tnx NEDXC)*

*Box 35, Hazlet, New Jersey 07730.

SSB HONOR ROLL

W2ZX	307	K8RTW	288	G2BVN	264	W7CMO	246
W2TP	307	W1LLF	282	W3DJZ	263	YV5AFF	240
TI2HP	306	W6UOU	282	G3DO	260	WØQLX	237
WØQVZ	305	W3KT	282	W4RLS	260	K1JMV	236
K4TJL	305	I1AMU	282	W6WNE	260	W3VSU	235
W2BXA	304	K4HYL	277	WA2EOQ	259	OZ7FG	234
G3AWZ	303	W7DLR	277	PJ2AA	258	W2PTM	231
G8KS	303	DL1IN	276	K1SHN	257	W6ZJY	228
5Z4ERR	301	HB9TL	276	KP4CL	256	W3FWD	226
W8PQQ	300	PZ1AX	275	K6CYG	252	K2JFV	223
K2MGE	297	W6RKP	274	K6LGF	251	K4JEY	221
W3NKM	296	K9EAB	274	W1AOL	250	W2MJ	215
W2RGV	296	W4SSU	274	W4OM	249	SM5UF	209
W2FXN	294	DL3RK	273	W4PAA	249	W5KC	206
W3MAC	293	W2LV	271	W4HUE	249	ZS6YQ	205
WA2IZS	293	G3NUG	270	W4NJF	248	W6USG	204
W4OPM	291	K8ONV	270	GM3JDR	247	KØUKN	202
W2VCZ	291	G2PL	266	XE1AE	247	G3HDA	200
K1IXG	289	W6YMV	265				

The following certificates were issued between the period from August 6th, 1966 to and including September 5th, 1966:

CW-PHONE WAZ

2328	DJ9NX	Ulrich Heuberger
2329	VK4SS	A. Shawsmith
2330	KØIFL	John M. Carter
2331	PY2CQ	Jose Rotenberg
2332	K1LWI	F. Wendell Boyden, Jr.
2333	CR7BC	Manuel Pereira DaSalva
2334	SP5YC	Antoni Pnybyzewski
2335	SM6AEK	K. G. Svenbrant
2336	OK1WV	Baclav Hubka

ALL-PHONE WAZ

341	OK1VK	Peter Bohuslav

TWO-WAY SSB WAZ

414	W6TGB	Jerry J. Kubek
415	DJ8CB	Lothar Kaiser
416	DL7EN	Dr. Hans-Gunther Todt
417	DJ9GD	Walter Misch
418	W5NUT	Gillia Wood
419	JA1BN	Akira Tani
420	OK1VK	Peter Bohuslav

CW WPX

738	WØTDR	Warren Bergmann
739	DJ9SB	Renata Krause
740	KØJAU	Dale R. Barrows
741	K3BTT	James N. Cuthbert
742	YO6AW	Victor Demianovschi
743	W8BEK	George M. Kinsey

PHONE WPX

132	VK2AIA	Muriel Eagles
133	GM3OCV	Daniel Francis Connor

SSB WPX

250	WA5LOB	James D. Edwards
251	WA4GCS	Robert H. Garlough
252	CT1IK	Eduardo Alberto P. V. Leal
253	KP4COX	Eugene Adair

MIXED WPX

124	K8AJK	Jerry Gadowski
125	PAØEEM	Reint P. Cremer
126	PY2CQ	Jose Rotenberg

100 TWO-WAY SSB

491	W7UVR	Leander J. Smith

200 TWO-WAY SSB

136	DL9OH	Karl Muller
137	W2FXE	William Tucker

300 TWO-WAY SSB

15	W2RGV	Jack Lee
16	W3MAC	Lewis J. Rapp

UG6 Armenia: UG6AW has been very active on 14110 at 0400 GMT. *(Tnx LIDXA)*

VP7 Bahama Is.: Bob, VP7EA, passes along the following on his operating from VP7 land. Bob may be remembered as KP4AMU or HS1AM.

"It may be of interest to some hams who would like to QSO the Berry Islands my operating habits and set up. I operate from a down range tracking station on Stirrup Cay, 62 miles N. W. of Nassau. I use a KWM-2 transceiver and TO keyer, and am mostly on c.w. The station is in the instrumentation trailer on the beach and antennas are doublets 100 feet high.

Amy, HB9YL, can be heard on any band. She recently worked W1BB on 160 for the first EU/W. XYL 160 meter crossing. Her OM, HB9TT is also very active. *(Tnx W1BB)*

"I operate mostly the low end of 40 c.w., around 7005 kc, high speed if possible but slow down to any speed for a QSO. I usually call CQ, however, at 60 w.p.m. QSL address is 700 Jane Street, Gastonia, N. C. or P.O.B. 48, Nassau, Bahamas. Usual operating time is 1900 EST until I run out of QSOs a few hours later."

VR1 British Phoenix: VR4IN/VR1 was activated from here for one day on 7 mc c.w. and s.s.b. He worked very few US stations and may return at some future date. *(Tnx LIDXA)*

VS5 Brunei: Jack, VS5JC, in the months he has been active has worked very few east coast stations. Since Jack would like to work those that need him most, he will be looking especially for W1, 2, 3, 4 and 8 stations from 12-1300 GMT, especially weekends. He will then pick up the rest of the country from 1300 on. Jack operates between 14030-035 but does move sometimes because of QRM. He listens as directed. He has a slight chirp and should be easily recognizable. *(Tnx W5VA)*

VS9K Kuria Maria & Kamaran: VS9ARV reports, via the NEDXA Bulletin, that all is still go for Kuria Maria and Kamaran between November 6th and 20th.

XW8 Laos: Ben Staurt, XW8BS, is using XW8AZ's gear and house now that John is QRT. He expects to be here another 1½ years. He works for the USAID. *(Tnx LIDXA)*

YA Afghanistan: YA1DAN very active from Kabul looking for W/K contacts on 14210-240 after 0200 GMT. *(Tnx PUERTO RICAN DXer)*

YK Syria: YK1AA, Rasheed active 0300 GMT 14220-240 s.s.b. *(Tnx PUERTO RICAN DXer)*

ZD9 Tristan Da Cunha: Active here is ZD9BE on 14 mc s.s.b. ZD9BE has a sked with GB2SM on Tuesdays and Thursdays on 14265 kc s.s.b. at 1600 GMT. *(Tnx VERON)*

ZL4 Campbell Is.: ZL4CH is looking for the states of Arkansas, Delaware, Kansas, Nevada, New Hampshire and Wyoming to complete his WAS. He can usually be found 14060-070 at 0400-0600 GMT on Saturdays. He has also appeared on 14170 and 14232 s.s.b. at these same times. *(Tnx NEDXA)*

3B/3C Canada: VO2AW passed along the following info: "As you probably are aware, in 1967 Canada will celebrate her Centennial Year. In order that we may help publicize this year, the Canadian Government has authorized the use of special calls by Canadian amateurs. They have authorized the use of the following prefixes for a period of one year from January 1st, 1967 to December 31, 1967. 3B1 for VO1, 3B2 for VO2, 3C1 for VE1, 3C2 for VE2, 3C3 for VE3, 3C4 for VE4, 3C5 for VE5, 3C6 for VE6, 3C7 for VE7, 3C8 for VE8 and 3CØ for VEØ. The last two or three letters, as the case may be, of the present calls will remain the same. The use of these special prefixes will be at the discretion of the amateur himself.

I personally will have special cards printed for use during this period. I imagine that there may be others who will also have special cards printed."

4S7 Ceylon: 4S7PB, Paddy, occasionally active from Colombo around 14225 s.s.b., 0300 GMT. *(Tnx PUERTO RICAN DXer)*

5H3 Tanganyika: Chuck, 5H3JR, is on almost daily at 1900 GMT on 21420. *(Tnx LIDXA)*

8F4 Indonesia: WØGTA/8F4—Bob is now QRV from Sumatra and is legal to be worked by the stateside boys. He has been active on 14227 listening 5 down but he says as the pileup grows, he will have to move to the low end of the band. He states that the best time to work the east coast is 0000 GMT. His beam is fixed on Europe. *(Tnx NEDXA)*

9H1 Malta: There is a Malta net active every Sunday on 21150 kc at 1000 GMT. 9H1AM is NCS and other modes welcomed. *(Tnx 9H1AS/WA4FIJ)*

John, WØGDH, getting set to make a big noise on 160. *(Tnx W1BB)*

The ever popular YK1AA. I'm happy to report Rasheed no longer has his foot in a cast. *(Tnx WØQLX)*

9N1 Nepal: 9N1MM and 9N1BG are active on 14 mc s.s.b. around 1500 GMT. Favored frequencies 14130 and 14270 kc. *(Tnx VERON)*

9X5 Rwanda: 9X5AV, Hadelin, has been on 21393 at 2100 GMT with excellent signals. The callbook address is incorrect. QSLs should go to Box 63, Cyangagu, Rwanda. *(Tnx VERON)*

160 Meters

The annual transatlantic and worldwide "top band" DX tests will be held on the following Sunday mornings 0500-0730 GMT. Dec. 4th and 18th—January 1st and 15th—February 5th and 19th. During these tests, special efforts will be made to establish new records. W/VE stations should call "CQ-DX TEST" the first five minutes of the hour and alternate periods thereafter—listening between. DX will call "CQ-DX TEST" the 2nd, 4th, 6th five minute periods thereafter—listening between. Adhere to this sked except when QSOs are in progress. Use authorized frequencies. W/VEs East, 1800-1825—West-1975-2000 kc. Europe 1825-1830—ZL/VK 1800-1860—JAs 1907.5-1912.5—Africans 1800-1825 mostly. All hams are reminded to be alert for unusual DX openings anywhere over darkness paths at sunrise or sunset times, either end of path just as long as path is in darkness and at or near twilight or sunrise at either end. This is just when 160 meter signals "PEAK." Write VE2UQ for special times sunset/sunrise for any path. These are TESTS not CONTESTS. It is for pleasure in an unusual operating activity, without competition and to develop propagation information which makes a worthwhile contribution to the art of radio. Send your resume report of tests to W1BB at the end of the season and progress reports after each test beginning February 1st for logging and reporting.

Special "First Timers" Test—Again by popular demand, these special tests will be repeated Sunday mornings 0500-0730 GMT. All of those on one side or the other, who have already crossed the Atlantic or worked real DX on 160 will QRT Stay off entirely on that particular morning to allow the FT stations who have never crossed before to have a go at it. One morning the Europeans, except for those who have never crossed before, will QRT. The next test, all W/VEs will QRT except for those who have never crossed before or worked real DX. On the opposite side, all including the "experts" will listen and try for QSOs with the FT on the opposite side. Here's hoping that all of the boys will cooperate 100% to help these FT. Please pass the word around so that these special tests and procedures will be well known to all. The dates for the first timer tests are as follows: For the European/African FT—all others QRT—Dec. 18th and Feb. 5th. W/VE/NA FT—all others QRT—Jan. 8th and Mar. 5th. Times and procedures will be the same as for the annual Transatlantic DX TESTS. Those on the opposite side from the FT should QRX and listen intently until a call to answer is heard. A special request to W/VE/NA stations is to stay below 1820 kc so as not to QRM the sector 1820-1825 where many Europeans must operate. It is suggested that weak Europeans and Africans use 1823-1827 kc as beat frequencies. Note that the W/VE/NA First Timers dates are in between the regular Transatlantic tests whereas the EU/AF FT tests are on the regular Transatlantic DX test dates. All of the selected dates are when good conditions can be expected for weak signals. *(Tnx W1BB)*

QTHs and QSL Managers

WA1DDG and WB6QQP would like to offer their services as QSL managers. Anyone interested may contact WA1DDG, Ed Frankel, 39 Russo Dr., Hamden, Conn. or WB6QQP, Lew Christy, 8212 Locust Ave., Fontana, California directly.

CM1AR	via OK1GL.
CM2BL	via OK1GL.
CN8FF	via W2GHK.
CN8FS	via W2GHK.
CR5SP	via W2GHK.
CT2JJ	via W6LDA.
DL4/DL5	QSL Bureau, c/o MARS Radio Stn., Hqs. 93rd Sig. BN APO NY 09175.
EL9MB	Box 448, Monrovia, Liberia.
FL8HM	via W7WLL.
GC2LU/P	via G2LU.
GC3POI/P	via W2CTN.
GC3SHZ/P	via W2CTN.
GW3DZJ	via W3HNK.
HBØAAI	via HB9AAI.
HM2BD	via WA6MWE.
I1GRO/M1	via ON5GA.
KG6IF	via W6ANB.
KG6IG	via K6ZDL.
exKH6FJL	John Fail QM1 USCG, USCGC Cape Higgon WPB 9532, 1911 Bayside Dr., Corona Del Mar, Calif. 92625.
KJ6DB	via KH6EOQ.
KS4CC	Box 1148, Miami, Fla.
ex KX6BK	(1963) via K6CAA.
KX6EN	via W1MV.
MP4BGA	via VE1AKZ.
MP4QBB	c.w. via W7VRO—s.s.b. via W8ZCQ.
TG8CV	Juan Cuesta Prado, Box 5, Retalhuleu, Guatemala
OD5BZ	via W8ZCQ.
OD5CN	via K4ISV.
OD5EP	via WB2ISL.
VP6KL	via VE40X.
VQ9EF	Box 191, Victoria, Seychelles
VR4LN	via W7WLL.
VS5JC	via W5VA.
WØGTA/8F4	via W2CTN.
XE1NE/XE1PNE	Alberto Calleja, Apartado Postal 2807, Mexico 1, D.F., Mexico
XW8BS	Ben Stuart, USAID, APO San Francisco, Calif. 96352.
YA1DAN	via KP4CL.
YA5RG	via DL6MB.
YN6BF	via VE3CKW.
YV7AV	Box 512, Carupano, Venezuela.
ZD8CN	via K2CNQ.
ZS8L	via W4BRE.
3AØID	via F9KF.
4S7YY	via WA4AYD.
5A2TZ	Box 372, Tripoli, Libya.
5R8AS	via W6ZPX.
9H1AS	via WA4FIJ.
9N1BG	via VE4OX.
9V1MT	H. Pain, JATCC (RAF) Singapore Airport, Singapore 19.
9X5AV	Box 63, Cyangugu, Rwanda.
9X5MH	via DL1ZK.
9Y4VU	via WA2CBB.

Propagation

BY GEORGE JACOBS,* W3ASK

THE c.w. section of the 1966 *CQ* World Wide DX Contest will be held over the weekend of November 26-27. Special DX Propagation Charts for use during the contest period appeared in last month's column. Be sure to check these Charts if you plan to take part in the c.w. section. The Charts contain predictions of band openings and other propagation data which could be useful in piling up points during the c.w. section of the contest. For a day-to-day forecast of general propagation conditions expected during November, including the contest dates, see the "Last Minute Forecast" appearing at the beginning of this column.

A seasonal rise in usable frequencies is forecast for November during the daylight hours. From a few hours after sunrise, and continuing through the late afternoon hours, it should be a toss-up between 15 and 20 meters as to which band will be optimum for DX propagation conditions to most areas of the world. Some fairly good 10 meter openings are also forecast during the daylight hours, especially on days when "above normal" propagation conditions are expected.

During the early evening hours and the sunrise period, both 40 and 20 meters are expected to share the honors for the best DX band. During the nighttime hours, optimum conditions are forecast for 40 meters. Some fairly good DX openings are also predicted for 80 meters to some areas of the world during the hours of darkness. An occasional 160 meter DX opening may also be possible during the hours of darkness and the pre-dawn period.

In the northern hemisphere, static and ionospheric absorption levels are expected to decrease considerably during November. This should result in exceptionally strong signals on many DX openings.

Short-Skip Charts

This month's column contains a Short-Skip Propagation Chart for use in the continental United States for distances between approximately 50 and 2300 miles. Special prediction charts centered on Hawaii and Alaska are also included. The Charts are valid through December 31.

Sunspot Cycle

The Zurich Solar Observatory reports a monthly sunspot number of 49 for August, 1966. This results in a smoothed sunspot number of 31, centered on February, 1966. A smoothed sunspot number of 60 is forecast for November, 1966. The new sunspot cycle, now beginning its third year, is rising at a somewhat more rapid rate than earlier in the cycle.

V.h.f. Ionospheric Openings

With increased aurora activity expected during November, some auroral-type v.h.f. openings are likely to take place, especially when conditions on the h.f. bands are below normal or disturbed. Check the "Last Minute Forecast" at the begin-

*11307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for November

	Forecast Rating & Quality			
Days	(4)	(3)	(2)	(1)
Above Normal: **7, 11, 16, 18**	A	A-B	B-C	C
Normal: **4, 6, 8-10, 12-13, 15, 17, 19, 21-22, 26-27**	A-B	B-C	C-D	D-E
Below Normal: **1, 3, 5, 14, 20, 23, 25, 28, 30**	C	C-D	D	E
Disturbed: **2, 24, 29**	D	D-E	E	E

HOW TO USE THESE CHARTS

The following is an explanation of the symbols shown above, and instructions for the use of the *CQ* propagation predictions:

1—Enter Propagation Charts on following pages under appropriate band and distance or geographical area columns. Read predicted times of band openings at intersection of both columns.

2—Following each predicted time of band opening is a forecast rating which indicates the relative number of days the band is expected to open during each month of the forecast period. The higher the rating, the more frequent the opening, as follows: (4) band open more than 22 days eacn month; (3) between 14 and 22 days; (2) between 8 and 13 days; (1) less than 7 days.

On the "Short-Skip" Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. Note the forecast rating for later use.

3—With the forecast rating noted above, start with the numbers in parentheses at the top of the "Last Minute Forecast" appearing above. Read down the table for a day-to-day forecast of propagation conditions in terms of Above Normal (WWV rating higher than 6); Normal (WWV rating 5-6); Below Normal (WWV rating 4); Disturbed (WWV rating less than 4). The letter symbols (A-E) describe reception conditions (signal quality, noise and fading levels) expected for each day of the month and have the following meanings: A—excellent opening with strong, steady signals; B—good opening, moderately strong signals, little fading and noise; C—fair opening, signals fluctuating between moderately strong and weak; D—poor opening, signals generally weak with considerable fading and noise; E—poor opening, or none at all.

4—This month's Propagation Charts are based upon a transmitter power of 75 watts c.w.; 150 watts s.s.b., or 300 watts d.s.b., into a dipole antenna one quarter-wave above ground on 160, 80 and 40 meters and a half-wave above ground on 20, 15 and 10 meters. For each 10 db increase above these reference levels, reception quality shown in the "Last Minute Forecast" will improve by one level; for each 10 db loss, reception will become poorer by one level.

5—Local Standard Time for these predictions is based on the 24-hour system.

6—These Propagation Charts are valid through Dec. 31, 1966. These Charts are prepared from basic propagation, data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

ning of this column for the days that are most likely to be in these categories during November.

The *Leonids* meteor shower is expected to take place during the middle of the month. This should result in some meteor-type ionospheric openings on the v.h.f. bands.

73, George, WSASK

CQ Short-Skip Propagation Chart

NOVEMBER–DECEMBER, 1966

Band Openings Given In Local Standard Time

AT PATH MID-POINT

(24-HOUR TIME SYSTEM)

Band (Meters)	*50-250 Miles*	*250-750 Miles*	*750-1300 Miles*	*1300-2300 Miles*
10	*Nil*	*Nil*	09-11 (0-1) 11-15 (0-2) 15-17 (0-1)	08-09 (0-1) 09-11 (1-2) 11-15 (2) 15-17 (1-2) 17-19 (0-1)
15	*Nil*	09-18 (0-1)	07-09 (0-1) 09-11 (1-2) 11-16 (1-4) 16-18 (1-2) 18-20 (0-1)	07-09 (1) 09-11 (2-3) 11-16 (4) 16-18 (2-3) 18-20 (1-2) 20-22 (0-1)
20	11-15 (0-1)	05-09 (0-1) 09-11 (0-2) 11-13 (1-3) 13-15 (1-4) 15-17 (0-3) 17-19 (0-2) 19-21 (0-1)	05-07 (1) 07-09 (1-3) 09-11 (2-4) 11-13 (3-4) 13-15 (4) 15-17 (3-4) 17-19 (2-3) 19-21 (1-2) 21-23 (0-1)	07-09 (3-2) 09-15 (4-2) 15-17 (4) 17-19 (3-4) 19-21 (2-3) 21-23 (1-2) 23-04 (0-1)
40	07-09 (1-2) 09-17 (3-4) 17-19 (2-3) 19-21 (1)	07-09 (2-3) 09-15 (4-2) 15-17 (4-3) 17-19 (3-4) 19-21 (1-3) 21-03 (0-2) 03-07 (0-1)	07-09 (3-2) 09-15 (2-1) 15-17 (3-2) 17-19 (4) 19-21 (3-4) 21-03 (2-4) 03-07 (1-3)	07-09 (2-1) 09-15 (1-0) 15-17 (2-0) 17-19 (4-3) 19-03 (4) 03-07 (3)
80	08-21 (4) 21-01 (3-4) 01-04 (2-3) 04-07 (1-2) 07-08 (2-3)	08-09 (4-2) 09-16 (4-1) 16-18 (4-2) 18-01 (4) 01-04 (3-4) 04-07 (2-4) 07-08 (3)	08-09 (2-1) 09-16 (1-0) 16-18 (2) 18-06 (4) 06-07 (4-2) 07-08 (3-1)	08-09 (1-0) 09-16 (0) 16-18 (2-0) 18-20 (4-3) 20-04 (4) 04-06 (4-2) 06-07 (2-1) 07-08 (1)
160	09-17 (1-0) 17-19 (3-2) 19-07 (4) 07-09 (3-2)	17-19 (2-1) 19-07 (4) 07-09 (2-1)	17-19 (1-0) 19-21 (4-2) 21-04 (4) 04-06 (4-2) 06-07 (4-1) 07-09 (1-0)	19-21 (2-1) 21-04 (4-3) 04-06 (2-1) 06-07 (1-0)

†Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST; and 10 hours *behind* GMT.
*GMT or Z Time is 5 hours *ahead* of EST; 6 hours *ahead* of CST; 7 hours *ahead* of MST; 8 hours *ahead* of PST; and 9 hours *ahead* of Alaskan Standard Time in the zone between Skagway and 141 degrees west longitude, etc.
‡Indicates possible 10 meter openings.
§Indicates possible 160 meter openings.

HAWAII

Openings Given In Hawaiian Standard Time†

To:	*10/15 Meters*	*20 Meters*	*40 Meters*	*80/160 Meters*
Eastern USA	07-10 (1)‡ 10-12 (2)‡ 12-14 (1)‡ 06-07 (1) 07-12 (2) 12-14 (3) 14-15 (2) 15-17 (1)	06-08 (2) 08-13 (1) 13-14 (2) 14-17 (3) 17-19 (2) 19-21 (1)	17-19 (1) 19-21 (2) 21-02 (3) 02-04 (1)	19-21 (1) 21-01 (2) 01-03 (1) 00-02 (1)§
Central USA	07-09 (1)‡ 09-11 (2)‡ 11-13 (3)‡ 13-14 (2)‡ 14-15 (1)‡ 06-07 (1) 07-13 (3) 13-15 (4) 15-16 (3) 16-17 (2) 17-18 (1)	06-07 (2) 07-08 (3) 08-13 (2) 13-14 (3) 14-17 (4) 17-18 (3) 18-19 (2) 19-22 (1)	17-19 (1) 19-20 (2) 20-02 (3) 02-03 (2) 03-04 (1)	19-21 (1) 21-02 (2) 02-04 (1) 00-03 (1)§
Western USA	07-09 (1)‡ 09-11 (2)‡ 11-14 (3)‡ 14-15 (2)‡ 15-16 (1)‡ 06-07 (1) 07-08 (2) 08-14(4) 14-16 (3) 16-17 (2) 17-18 (1)	06-07 (2) 07-10 (4) 10-15 (3) 15-17 (4) 17-18 (3) 18-19 (2) 19-23 (1)	17-18 (1) 18-20 (2) 20-01 (4) 01-04 (3) 04-06 (2) 06-07 (1)	18-19 (1) 19-21 (2) 21-04 (3) 04-05 (2) 05-06 (1) 21-05 (1)§

ALASKA

*Openings Given In GMT**

To:	*10/15 Meters*	*20 Meters*	*40 Meters*	*80/160 Meters*
Eastern USA	20-23 (1)‡ 17-18 (1) 18-21 (2) 21-23 (3) 23-00 (2) 00-01 (1)	16-22 (1) 22-02 (2) 02-04 (1)	06-12 (1)	07-11 (1)
Central USA	20-00 (1)‡ 17-18 (1) 18-21 (2) 21-00 (3) 00-01 (2) 01-02 (1)	16-20 (1) 20-23 (2) 23-02 (3) 02-03 (2) 03-04 (1)	06-14 (1)	07-12 (1)
Western USA	20-01 (1)‡ 17-20 (1) 20-21 (2) 21-00 (3) 00-02 (2) 02-03 (1)	16-18 (1) 18-20 (2) 20-22 (3) 22-00 (4) 00-02 (3) 02-04 (2) 04-06 (1)	02-03 (1) 03-05 (2) 05-14 (3) 14-15 (2) 15-16 (1)	04-06 (1) 06-14 (2) 14-16 (1) 12-14 (1)§

New Amateur Product

Apollo Engraving Co.

APOLLO Engraving now offers a personalized desk plaque custom engraved with your call letters. The plaque measures 2 × 6 inches and is mounted on a lucite base with gold colored trim. The plaque is available in several colors (walnut, mahogany, blonde oak, black, white) and is decorated with a miniature mike. The desk plaque sells for $2.50. For further information write to Apollo Engraving Co., 191 No. Hickory Street, N. Massapequa, N.Y., 11758, or circle 66 on page 110.

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

October	**22-23**	**CQ WW DX Phone**
October	29-30	RSGB 7 mc Phone
October	29-30	VU2/4S7 DX Phone
October	29-31	Maryland/DC QSO Party
November	2-3	YLRL Phone Party
November	5-7	Delaware QSO Party
November	12-13	OK DX C.W. Contest
November	12-13	RSGB 7 mc C.W.
November	12-14	ARRL SS Phone
November	19-21	ARRL SS C.W.
November	**26-27**	**CQ WW DX C.W.**
December	3-4	New England QSO Party
December	10-11	New Hampshire QSO Party
December	10-12	Zero District QSO Party
December	17-19	Ohio QSO Party

RSGB 7 mc DX

Phone—Oct. 29-30 **C.W.**—Nov. 12-13
Starts: 1800 GMT Saturday. **Ends:** 1800 GMT Sunday in each instance.

If you're a 40 meter fan this is a good one for you. Check rules in last month's CALENDAR.

Logs go to: R.S.G.B. 7 mc Contest Committee, 28 Little Russell St., London WC1, England. Postmarked no later than November 28th.

VU2/4S7 DX Phone

Starts: 0600 GMT Saturday, October 29
Ends: 0600 GMT Sunday, October 30

The c.w. section has already taken place, see the September CALENDAR. Your log for that one and the coming Phone section go to: A.R.S.I. Contest Committee, P.O. Box 534, New Delhi 1, India. Mailing deadline is November 15th.

Maryland/DC QSO Party

Starts: 2300 GMT Saturday, October 29
Ends: 0100 GMT Monday, October 31

Rules are a bit different than the usual State Party. Check last month's CALENDAR.

Mailing deadline for logs is November 21st. They go to: Carl E. Andersen, K3JYZ, 14601 Claude Lane, Silver Spring, Maryland 20904

YLRL Phone Party

Starts: 1700 GMT Wednesday, November 2
Ends: 2300 GMT Thursday, November 3

See page 32 of September's *CQ* for detailed outline of the rules.

Your logs for this one as well as the c.w. section that has already taken place go to: Edie McCracken, K1EKO, P.O. Box 285, Westwood, Mass. 02090. Mailing deadline is November 25th.

*14 Sherwood Road, Stamford, Conn. 06905.

Delaware QSO Party

Starts: 2300 GMT Saturday, November 5
Ends: 0500 GMT Monday, November 7

Conventional rules for state parties are used in this one. Complete rules and frequencies will be found in last month's CALENDAR.

Mailing deadline is December 5th and logs go to: Delaware A.R.C., c/o J. E. McCarley, K3NMY, P.O. Box 201, Newark, Delaware.

OK DX C.W.

Starts: 0000 GMT Sunday, November 13
Ends: 2400 GMT Sunday, November 13

This is a world wide contest so don't confine your operation to working Czech's only.

1. Use all bands, 1.8 thru 28 mc c.w. only.
2. There are three divisions: **A.** Single operator, All Band, **B.** Single operator, Single Band. **C.** Multi-operator, All Band.
3. The number exchange will be five figures, RST report plus two figures indicating the number of years the operator has been active in amateur radio. (*ie:* active since 1936, 57930) Multi-operator and club stations will use date station was licensed.
4. Each completed contact counts 1 point, but 3 points if it's with a Czech station. The same station may be worked once per band. Contacts with stations in the same country have no QSO point value but can be worked for prefix credit.
5. The multiplier is determined by the number of prefixes worked on each band. (WPX list.)
6. Final score therefore will be the total contact points multiplied by the sum of the prefixes from each band.

Although Gene Walsh won a pair of trophies back in the 1963 Contest as 5A1TW, he did not get to see them until a few months ago when he terminated his overseas duties and came back home. In last year's Phone Contest he also operated as DJØNO. This year he expects to show up as K2KUR.

7. Use a separate log sheet for each band and show in this order: Date/time in GMT, station worked, number sent, received, contact points and prefix. (First time worked only.)

8. Include a separate summary sheet showing the scoring and other pertinent information and your name and address in BLOCK LETTERS. Also include a signed declaration that all rules and regulations have been observed.

9. Certificates will be awarded to the highest scoring station in each country in each division.

10. Contest contacts may be applied for the 100 OK (worked 100 Czech stations) and the S6S (worked all continents) awards. A written application must be submitted with your log.

11. Logs go to: The Central Radio Club, Post Box 69, Prague 1, Czechoslovakia. Mailing deadline is December 31st.

ARRL SS

Phone—Nov. 12-14 **C.W.**—Nov. 19-21
Starts: 2100 GMT Saturday. **Ends:** 0300 GMT Monday in each instance.

This one really tears up the pea patch. You can either join them or stay off the air, especially for the c.w. week-end.

The message exchange will be the QSO number, two digits indicating the year first licensed, section and month and day (not year) of your birth. November *QST* will have all the details.

Request for free log forms and the finished product go to: ARRL Communication Dept., 225 Main Street, Newington, Conn. 06111

New England QSO Party

Three operating periods. (EST)
7:00 to 11:00 P.M. Saturday, December 3
7:00 to 11:00 A.M. Sunday, December 4
7:00 to 11:00 P.M. Sunday, December 4

Complete rules and operating frequencies for this popular Seven/Eleven QSO Party will appear in next month's CALENDAR.

Zero District QSO Party

Two operating periods (GMT)
0200 to 0500 December 10
2300 Dec. 10 to 0300 Dec. 12

This is a new one in which it will be possible to work all the states in the 10th district. An excellent opportunity to add to your WAS list as well as your USA-CA.

Complete details in next month's CALENDAR.

New Hampshire QSO Party

Three operating periods. (EST)
7:00 to 11:00 P.M. Saturday, December 10
7:00 to 11:00 A.M. Sunday, December 11
7:00 to 11:00 P.M. Sunday, December 11

The 17th New Hampshire QSO Party has been scheduled to a month later than in previous years. There are no changes in the rules however and they will appear in details in next month's CALENDAR.

Ohio QSO Party

Starts: 2100 GMT Saturday, December 17
Ends: 0300 GMT Monday, December 19

Rules for the second annual Ohio QSO Party will also be given in next month's CALENDAR.

CQ WW DX C.W.

Starts: 0000 GMT Saturday, November 26
7:00 P.M. EST Friday, November 25
4:00 P.M. PST Friday, November 25
Ends: 2400 GMT Sunday, November 27
7:00 P.M. EST Sunday, November 27
4:00 P.M. PST Sunday, November 27

With improving conditions and increased participation this one should exceed all previous contests. You can lighten our work by observing a few simple rules before submitting your log.

Remember, its the contestant's duty to score his own log and check its accuracy. It is suggested that duplicate contacts be left in your log even though they have been crossed out and no credit taken. Leave your log in its original form.

A summary sheet showing the scoring and other essential information and your name and address TYPED or PRINTED is a *must*. If you run out of log sheets and use regular paper, keep the entries at 40 to the page.

And we solicit interesting photos of your contest operation or your station.

Check the rules in details on page 49 of the September issue and last month's CALENDAR for some operating hints.

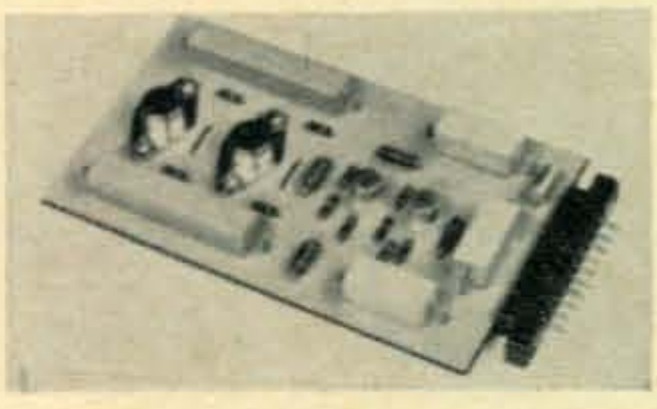
Once again, the mailing deadline for your phone entries is December 1, 1966 and January 15, 1967 for your c.w. logs. Please indicate if the enclosure is a phone or c.w. entry.

Address is: *CQ* WW DX Contest, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050

Good luck, see you in the pile-ups.

73 for now, Frank, W1WY

New Amateur Products



ESSCO

THE ESSCO Co. which specializes in teletype equipment is now offering a new selector magnet driver. The unit is all solid state, and will drive two 60 ma or two 20 ma (or any combination) selector magnets. It is available as either single or dual driver, and either kit or factory assembled. It measures 3 × 5 inches and can be assembled in less than 30 minutes. The basic price is $18.95 and runs to $24.95 depending which model you want. For complete specs, write to ESSCO, 324 Arch St., Camden, N.J. or circle 67, on page 110.

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See June 1966 QST For Details

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Model HA-350

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14.0 — 14.5Mc	WWV at 15Mc

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For further information, check number 6, on page 110

HAM CLINIC

CHARLES J. SCHAUERS,* W6QLV

It has been pointed out in this column before that there never has been nor will there ever likely be produced a completely 100% foolproof piece of radio-electronics equipment that will not fail. One faulty resistor, capacitor, tube, transistor or other component can cause a set to become entirely inoperative or malfunction. With this in mind then, we publish troubleshooting questions on ham gear in HAM CLINIC.

With the advent of solid state devices (especially transistors) the MTBF (meantime between failure) has increased tremendously. This means many more operating hours without failure.

Too often hams blame a set manufacturer for set trouble when in reality they should point their fingers at component manufacturers. All manufacturers of ham equipment (and others) have had problems at one time or other with component quality control and this is likely to continue when it is considered that mass production techniques prevail.

Testing to destruction is not the answer to provide more reliable components. The only thing a manufacturer can really do is to design equipment so that the components used are in proper circuitry and operated well within their ratings.

Most ham equipment manufacturers who have been in business for any reasonable length of time *do* correct fualts as they occur and do pass on the necessary modification information to those owners who request it. This helps the ham and enhances the manufacturers reputation by instilling confidence in the ham buyer.

All hams realize that a manufacturer must change his design from time to time, substitute more reliable and better parts and work for an improved product. If he didn't he would soon go out of business.

So the next time you feel like writing an angry letter to a manufacturer, think of your distributor first—it is his responsibility to give you satisfaction, but failing this, then it is up to the factory.

No lab can duplicate field operating conditions as they are—there just is not enough time—so there are bound to be troubles regardless of how good the product it.

Ham sets do change hands and the second-hand owners do not appear on manufacturers' mailing lists. In HAM CLINIC we try to present as much service information as we can on both new and older sets to keep the second-hand owner up to date. Manufacturers are encouraged to continue to send in service information to HAM CLINIC as it becomes available—and hams are requested to pass on service tips they have acquired the hard way.

Questions

SB-100 Hum—"I bought the SB-100 s.s.b. transceiver kit, put it together and it worked beautifully. I still get terrific signal reports but the set has suddenly developed what seems to be an a.c. hum on receive. I've checked and checked and cannot locate the trouble. Any hints?"

Yes. First check all tubes and especially look for a tube with a cathode to heater short—bet this is your trouble. Check the tubes hot and cold. If the tubes are okeh then check filter capacitors, diodes etc. in the HP-23 power supply. If these steps do not find the trouble, check for poorly soldered connections, especially those associated with grid circuits. Look for any "cross-over" shorts between lines on the printed circuit boards. The SB-100 is receiving excellent reports.

Transceivers and Phone Patches—"I acquired a KWM-2 and am now contemplating hooking up a phone patch. Can you pass on any words of wisdom relative to using phone patches with transceivers?"

A few. Remember that no phone patch is to be used to activate the v.o.x. circuits, the switching over must be done manually. Next, try to avoid direct connection to a phone line—use an inductive pickup (with an amplifier if necessary). The simple patches (using mike and headphone jacks) are best. The main trouble with most home-made patches is that not enough attention is given to proper impedance matching between transceiver and phone lines. Next in order is a poor ground. All patch lines should be shielded. AF feedback from the station phone sometimes occurs and causes distortion and oscillation (when the phone is used as a monitor), but the feedback more prevalent with transceivers is r.f. feedback. Most transceivers have enough mike amplifier gain to handle any patch, but there is a tendency on the part of some operators to over-drive the gain at times. To take advantage of your transceiver's af bandpass characteristics it may be necessary to design and install compensating networks if you want voice quality when on patch.

---

*c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y.

HAM CLINIC is a free technical question and answer service provided exclusively by *CQ*. Every attempt is made to answer each reader's question as promptly and accurately as possible. Occasionally, even HAM CLINIC is stumped, but it rarely happens. Readers are requested to enclose a stamped, self addressed envelope with their questions, to facilitate fast replies. For *extra* fast service, write directly to: Ham Clinic, c/o Chuck Schauers, W6QLV, 4 Lutzelmatte Str., Luzern, Switzerland. Enclose two IRC's. Normal inquiries: Ham Clinic, c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

SB-34 Transceiver Technotes

The Single Sideband Engineers (SBE) SB-34 hamband transceiver has met with spectacular success. It is the only transistorized ham transceiver (except for driver and final r.f. stages) that *contains* two power supplies (12 volts d.c. and 117 volts a.c.). Because it is so small it has really become the portable "standard" for hams all over the world.

The forerunner of the SB-34, the SB-33, is also a fine set and these are being snapped up by hams as they enter the second-hand market.

But the SBE engineers have not been idle. All good things in radio-electronics can be made better providing time, money and engineering talent are available—SBE has these.

What makes the SB-34 a good set is that the SBE engineers are constantly improving it. As better components (especially transistors) become available, SBE tries them and if successful, incorporates them into late production models.

The following tech notes are presented to current SB-34 owners (and second-hand owners to be) who are not on SBE's service bulletin mailing list. Again we urge all *set* owners (of any manufacturer) to send in your warranty cards when you obtain your set—the loss is yours if you don't.

A.C. Fuse Addition—Units with chassis numbered **17** or below did not incorporate fuse protection when operated from an a.c. source. Adequate protection may be attained by the addition of a 3 amp Slo-blo fuse in series with pin 5 of the set's power socket. To make the job easy, buy a fused a.c. male plug and replace the old plug with this.

Power Inverter Transistor Protection—Under certain conditions, the voltage appearing across C_{57} and C_{68} may be in excess of the voltage of these components in chassis numbered **18** or under. It is recommended that C_{57} and C_{68} be replaced with 50 mf, 50 volt electrolytic capacitors. This change will insure greater dependability of the power inverter.

Improvement of Microphone Amplifier Circuit—To increase microphone gain in chassis numbered **16** or below, C_{11} should be changed to a 10 mf, 15 volt electrolytic capacitor. C_{11} is located in the right rear corner of the i.f. board. This change will provide approximately 6 db additional gain.

a.g.c. Circuit Improvement—Although the a.g.c. circuit of the SB-34 is excellent, it can be improved still more by substituting Q_3 transistor with a 2N3642 transistor in those sets having chassis number **15** or below. If a 27 ohm resistor is in series with C_{21}, it should be removed and a jumper installed in its place. Check to see that R_{22} is 4.7K ohms. If not, make the appropriate changes.

Power Inverter Hash—If noise from the d.c. power inverter interferes with receiver operation, connect a length of #14 solid insulated wire to points indicated on the diagram in fig. 1. Remove the rear/center hold-down screw on the i.f. pc board and enlarge the hole to ¼ inch. Insulate the mounting foot using an appropriate size of insulating material such as fish paper or electrical tape between the printed circuit and the mounting foot. Replace the hold-down screw making sure that it does not make contact with the printed circuit board ground as it passes through the hole. After these changes have been made, the carrier balance and the alignment of transformer T_2 should be checked. This change has been installed in chassis number **28** and above.

Talk-Back—"Talk-back" may be recognized by hearing the transmitter signal coming back through the speaker. This problem may be encountered when the transceiver is used in conjunction with a linear amplifier, a poorly matched antenna, or a system with less than optimum grounding. Talk-back may be eliminated by adding a .1 mf 100 volt disc capacitor between the emitter and base of Q_1 in early models.

Improved Keying—If Q_{16} and Q_{17} keying transistors should ever fail they should be replaced with new silicon type transistors type 2N3642, in early models of the SB-34. It is a wise thing too when making the change to replace R_9 (3300 ohms ½ watt), R_{10} (680 ohms ½ watt) and R_2 should be added if found lacking. See fig. 2 for component locations.

Faulty keying transistor symptoms vary depending on the degree of leakage. The transistors may be suspected if any malfunction occurs which involves transmitting and receiving functions occuring simultaneously, or intermittent or erratic switching from one mode to the other.

Thank you SBE for helping us. Next month, we'll present some information on SBE accessories.

32S-3 v.o.x. Circuit Improvement—"Has any information been made available on the Collins 32S-3 transmitter to improve the v.o.x. circuit to eliminate intermittent dropout? I own a second-hand set that does this."

Yes. But the information is too lengthy to present here. Suggest you write Collins Field Service Department and ask for their Bulletin

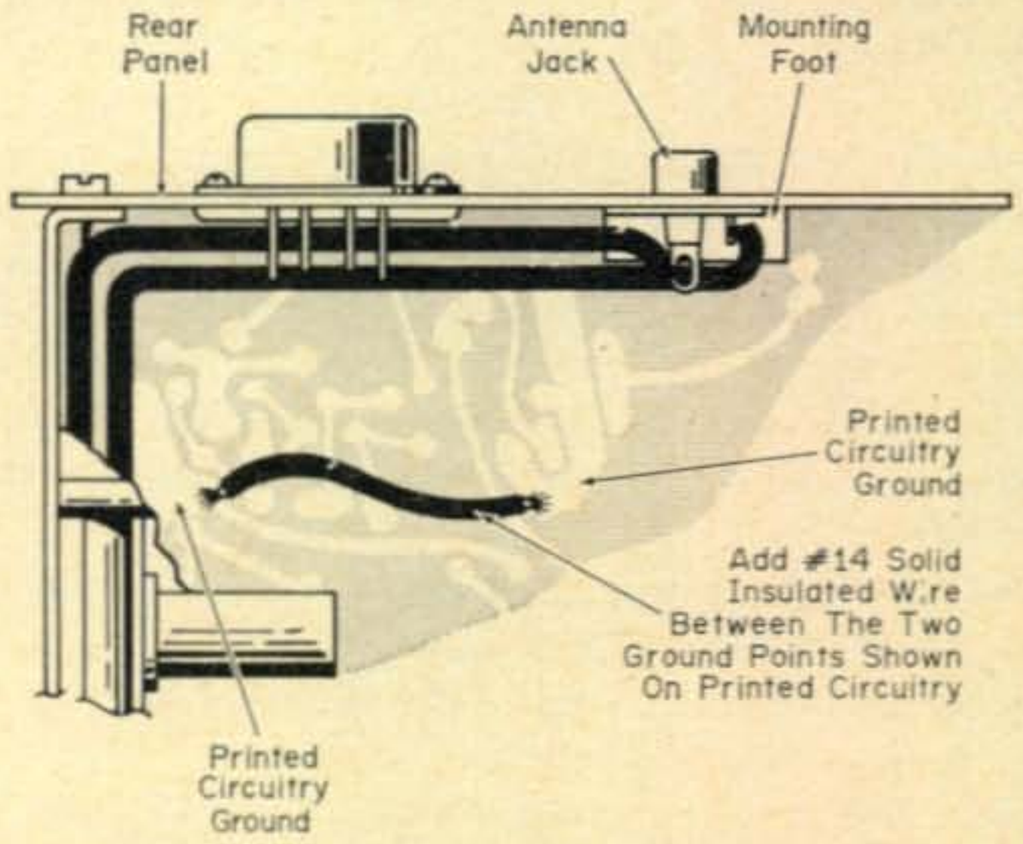

Fig. 1—The necessary steps to eliminate power inverter hash in SB-34 transceivers with chassis numbered 27 or below.

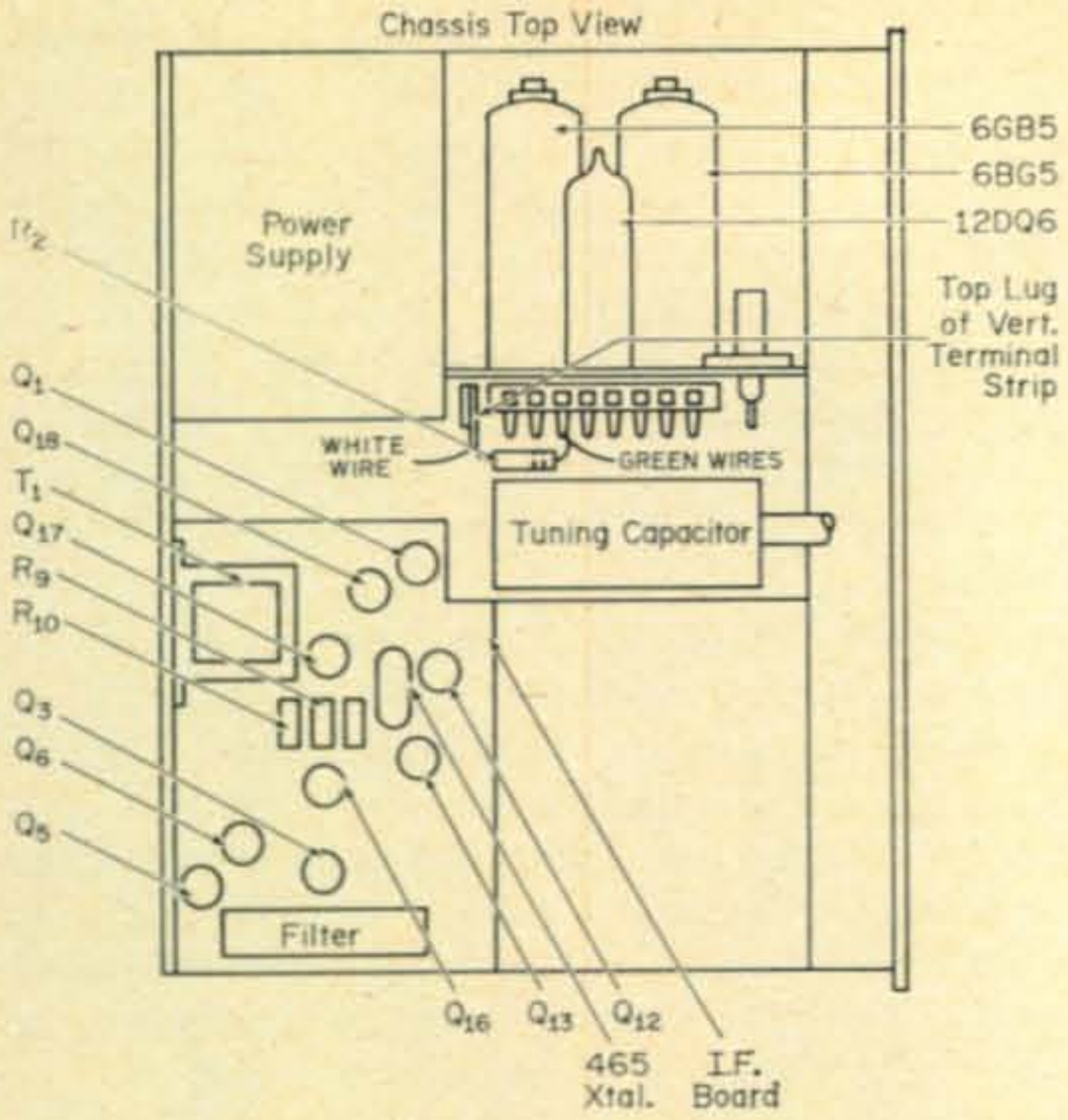

Fig. 2—The parts layout effecting the changing of transistors etc. in the keying circuit of the SB-34.

No. 5, dated November 6, 1963. Three capacitors are required for the change.

75S-3 b.f.o. Parasitic Oscillation—"I own an early model 75S-3 receiver by Collins. With the b.f.o. (tunable) turned on, the signal is nearly overridden by background noise and has a chirping or unsteady note. What can be done?"

Write Collins Radio Field Service Department for their service bulletin No. 1 dated 1 November 1962. It contains step-by-step instructions on how to eliminate the trouble. A resistor and a stand-off are all that are required.

Galaxy V Noise Feedthrough—"My Galaxy V works fine in the car on transmitting but on receiving I can hear the oscillator whine from my homebuilt d.c. power supply. I have tried everything to eliminate the high pitched noise but without success. What do you suggest?"

Buy a Galaxy d.c. supply. The following steps can be tried. First take a 1000 mf electrolytic capacitor rated at 15 volts and tie it right across the battery. If this does not help, obtain a frequency counter and measure the frequency at which your power supply is operating. With this frequency in hand, try a *series* filter to the set using the proper components. This is nothing more than a low frequency trap (2000 cycles plus). Make sure the wire you use for the coil (or choke) is large enough to carry the load. A separate battery sometimes will clear up the trouble.

NCX-5 Mike Input Z—"I have tried a number of mikes with my NCX-5 and find that all seem to lack the punch I expect. Any suggestions?"

Believe it or not there *is* the "best" mike for the NCX-5. This means a mike that is tailored to the a.f. characteristics of the set . . . and this applies equally to other transceivers. Having used an NCX-5, I recommend the Shure 444. Some hams make the mistake of feeding a low or medium impedance mike to a high impedance input—for best results this should not be done. Other mikes will work with the NCX-5 besides the Shure 444, but the latter has fine frequency response for s.s.b. work. Do check the mike amplifier tubes in your NCX-5.

SX-146 and HT-46—"I just received my general class license and my father gave me $575.00 for equipment. I want a receiver and transmitter (not a transceiver—this will come later). What can you recommend to me for my money?"

If I were you I would take the Hallicrafter "twins" the SX-146 receiver and the HT-46 transmitter. For separate sets you could hardly do better believe me. The sets are small, weigh little (about 46½ pounds together) and cover five bands. Plenty of power to start with. Let me know how you make out.

HQ-180 Antenna Coil—"I was operating on 40 meters the other day with my HQ-180 receiver and HT-37 driving a linear when the transmitter quit. In my haywire setup here I accidentally connected the full output of my linear to my receiver antenna input and the set stopped working. What do I look for?"

Did you see any smoke? Maybe your antenna coil is shot in your HQ-180. To obviate this (again) connect a NE-2 neon bulb from receiver input (antenna) to ground. This may save future antenna coils . . . and other components.

Swan 240 Technotes

Low Sideband Suppression—If low sideband suppresion reports are received check the crystal lattice filter, p.a. load adjustment, mike gain (over-driving) and carrier frequency crystal.

Microphonics—On receive if microphonics seem to be present, first of all check for a gassy 7360 tube. Then check the 2nd i.f. tube, a 6BA6; exchange it with V_5 another 6BA6. Also check the 12AX7 and 6U8A tubes.

Unstable p.a. Idling Current—First look at and check the wirewound p.a. bias pot. Next check the bias voltage and look for other power supply troubles. Then check to see if the 6DQ5 is gassy.

Thanks Swan.

Thirty

Whenever we can, we try to avoid publishing questions, the answers to which may be found in current radio handbooks, magazine indices or manufacturers' or dealers catalogs, for these are all readily available to the average ham. On the other hand, if we receive a *number* of letters on the *same* subject you can expect that we will publish the question and answer. It takes a lot of library, technical manuals, service sheets etc. to answer HAM CLINIC readers' questions and we ourselves learn a lot in the process of digging out the answers. If you like the column and would like to see it continued write the editor and publisher, don't write me on this subject. We do like to hear from readers however, questions or no! 73 for this month then.

73, Chuck, W6QLV

the USA-CA PROGRAM

BY ED HOPPER,* W2GT

THE November "Story of The Month" is about "Pappy," WA9AJF, but first this data on awards issued. Mabel, K5SGJ, received #8 USA-CA-3000 award, the first to a YL/XYL, and Ken, K4VOF, was close behind with #9 USA-CA-3000. Mabel also received All s.s.b. endorsement for her USA-CA-1000 award. Rod, W9CMC received a USA-CA-2500 award and he also received All 7mc s.s.b. endorsement for his USA-CA-1500 award. A USA-CA-2000 award went to Don, KØHUU. Bertha, WA4BMC earned a USA-CA-1500 award and endorsements of All 14mc s.s.b. for her 1000 award and All 7mc, All s.s.b. and All 14mc for her USA-CA-500 award. Kirk, K1MRI received a USA-CA-500 award endorsed All 50mc A-3 (#3 such award issued). Oscar, W3YFI won a USA-CA-500 award endorsed All A-1. Mixed USA-CA-500 awards went to Thomas, K1VGM; Robert, WA3APO/4; Charles, K4FRM; Mike, K4TBN; Tony, KØOAL and "Rag," LA5HE.

USA-CA HONOR ROLL

3000

K5SGJ 8
K4VOF 9

2500

W9CMC 17

2000

KØHUU 30

1500

WA4BMC 54

500

K1MRI 586
KØOAL 587
W3YFI 588
LA5HE 589
K4TBN 590
K1VGM 591
WA3APO/4 592
K4FRM 593

SPECIAL USA-CA HONOR ROLL
Top Twenty-Five County Hunters

K9EAB	3079	K4VOF	3000	W9CMC	2501
WØMCX	3079	K5SGK	2960	WØGYM	2500
K8CIR	3075	K8KOM	2803	W8UPH	2414
W9ICF	3050	K8IWI	2780	K3LXN	2331
WA9AJF	3010	W5EHY	2779	K8VSL	2180
WØJWD	3005	VE3-9301	2679	K8EUX	2154
K5SGJ	3002	WØKZZ	2632	W5NXF	2080
W2QHH	3001	WØVFE	2527	WA5AEB	2062
				W2JWK	2050

Clyde "Pappy" Bidgood, WA9AJF
#7 USA-CA—3000 Winner

Our septuagenarian county hunter in Elmhurst, Illinois, obtained his amateur license in 1961 although he says he should have obtained one thirty years or more earlier as many of his co-workers were hams and often held their field day exercises on a farm he owned in the early thirties.

"Pappy" learned the code back in 1909 when he worked for the old Postal Telegraph Co. in Kokomo, Indiana. Then to Western Union; back to Postal in Salt Lake City; to Butte, Montana and on to Calgary, Alberta, Canada the winter of 1911-12 where you worked as many hours as you could endure due to a shortage of operators. While he copied many tragic and interesting stories while with the Associated Press, probably among the most memorable was the one about a young married couple on a chunk of ice that broke loose at Niagara Falls and headed towards the rapids below. The groom had a chance to save himself with ropes dropped from the bridge but when he was unable to save his wife, he refused to save himself and went to his death along with her.

He was in Newark, Ohio, during World War I and helped run the extras for the *Newark Advocate* announcing the end of the war. That was long before radio and television, and although now called the horse and buggy days, at that time they were considered tops. When the war ended, "Pappy" put in 82 consecutive hours, typing 75,000 words when the story broke. At that time, 15,000 words was considered a heavy day's work. He and a man on the opposition paper were the only ones in Newark who knew the complicated Phillips code used on all press wires.

He later worked as Chief Operator for E. A. Pierce & Co. (now M.L.P.F. & S.) from about 1924 to 1929 when they helped him obtain a

*103 Whitman St., Rochelle Park, N.J. 07662.

WA9AJF and Equipment.

MABEL, K5SGJ, #8 USA-CA-300 and ARCY, K5SGK. See the story in CQ, FEB, '66.

membership on the Exchange. Three weeks before the crash (1929), he obtained a membership on the Chicago Stock Exchange and for the next 30 years represented Merrill, Lynch, Pierce, Fenner and Smith. During that time he saw the transition of Morse operation to the tele-type and the improvement of that mode of handling news from a 30 word per minute machine to well over 100 words.

"Pappy" had his first coronary heart attack on the floor of the Midwest Stock Exchange December 7, 1956. Another one occurred in 1958 and two more in 1959 from which he barely recovered. However as "Pappy" says, "The Good Lord seems to have had me by the hand and led me into a path of activity that I can do and enjoy within my limitation."

His biggest problem was inactivity. Everytime he tried some of his old hobbies he got into trouble. Such things as cross word puzzles, photography, learning to play an electric organ and tropical fish with from one to thirty tanks, just did not seem to fill the bill.

Then on the recommendation of a local doctor, who is a ham, "Pappy" became interested in amateur radio. The code was no problem and he applied himself diligently to the theory and thus WA9AJF came into being.

Many honors have been bestowed upon "Pappy," including The Press Publications board of editors naming him "Citizen of the Month"; a valued member of civil defense; active member and treasurer of the York Radio Club; being named a Kentucky Colonel for his services to that state through his hobby. And as for handling traffic, he has certificates for handling in excess of 500 messages per month for 18 consecutive months.

Although "Pappy" enjoyed handling traffic and calling people with messages from friends and relatives, especially from overseas personnel, after the 53rd cardiogram showed his heart needed more rest, it was necessary to cut down on traffic work and for some time the main effort has been county hunting.

His USA-CA record is as follows: USA-CA-500 award #237 in June 1963; #22 USA-CA-1000 award in January 1964; #9 USA-CA-1500 award in May 1964; #9 USA-CA-2000 in October 1964; #10 USA-CA-2500 in April 1965 and #7 USA-CA-3000 award in August 1966.

Due to this heart condition, he keeps an oxygen tank in his home and one in the car and his wife is always nearby. He has had 41 angina heart attacks since the first of 1966 that required nitro-glycerin, oxygen and hypos administered by his good wife who is a Registered Nurse. These attacks cause severe chest pains and difficult breathing and the medical boys insist he would not be around if it were not for the good care from his wife. She is the former Lottie Boeske, they have three children: Robert, Phyllis and Thomas and 10 grand children. I am sure some AWARDS should be sent to Lottie.

The Grand Club Award. Black Gold Award

Islands On The Air Award.

Letters

Mal, K4RIN, writes, "There seems to be some confusion among county hunters regarding my recent operations. I operated from Hinds county Feb. 15, '66 to Aug. 15, '66 and Yazoo county Aug. 20, '66 to Sept. 10, '66—both in Mississippi. I have never operated from Warren county, Miss. I will operate from Walker county, Georgia *and* Hamilton county, Tennessee starting Sept. 15 for an undetermined period."

Several letters about Independent Cities make this explanation necessary, especially to the new county hunters. The only such cities that need attention are the 35 in Virginia, as Baltimore and St. Louis are already taken care of in the Record Book. The rule is that Independent cities or parks not legally within counties may be used for credit (only *once*) for an adjacent county.

Awards

Black Gold Award: Sponsored by the Tulsa Council of Amateur Radio Clubs of Tulsa, Oklahoma, "The Oil Capital of the World." The requirements are: DX stations required to work 2 Tulsa stations or club station (W5OK) and one other. K/W stations work 5, or club station (W5OK) and 3 others; v.h.f. stations work club station and 1 other or 3 members. Send $1.00 or 10 IRCs with certified list (General Certification Rule) to John Haws, WA5BXX, 1927 S. Knoxville, Tulsa, Oklahoma 74112. No special time requirements for contacts.

The Grand Club: A two meter operating achievement award sponsored by The Grand Club of Ohio, to help stimulate more two meter activity. Requirements: 200 or more two meter confirmed QSOs, with no date or time limit. Send $1.00 and list of confirmed contacts certfied by two general license signatures (General Certification Rule) to Jerry Welch, K8YWF, 185 Longfellow Drive, Tiffin, Ohio 44883. Recipients of this award become members of The Grand Club.

Islands On The Air: Awards issued by Geoff Watts, *DX News-sheet,* 62 Belmore Road, Norwich NOR. 72-T, England. IOTA awards are available to licensed amateurs and s.w.l.s for confirmation of QSOs with amateur stations located on islands throughout the world. Some 11 awards are available for working islands on the 6 continents; Antarctica; Artic; British Islands; West Indies; World Award and Century Club Award

[*Continued on page 105*]

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100kc Calibrator Kit for 350		19.50
500kc Calibrator Kit for 250		19.50
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SURPLUS sidelights

BY GORDON ELIOT WHITE*

For the second of my three-part series on the Navy battleship receivers of World War II, I will discuss the RBA, RBB, RBC sets. These, as I intimated last month, are designed to be used aboard ship, in fact were designed to withstand the shock effect of heavy naval gunfire and to retain their oscillator stability despite large fluctuations in the primary power supply voltage.

An examination of the RBA and its series sisters will show just how husky was the design, and how little regard was given to "miniaturization." Of course there are many larger receivers in the services; the AN/FRR-24 is a more recent "monster," but it contains a great deal more equipment than the older units.

The RBA is a *T*uned *R*adio *F*requency set of course, and only uses a local oscillator as a b.f.o., but in the RBB and RBC the h.f. oscillator which feeds the mixer in the superheterodyne circuit is stabilized as to heater voltage by an Amperite 6-8B ballast tube fed from a special 17 volt filament tap in the power transformer. Since the ballast tube is expensive and difficult to find these days, I have generally done away with it, taking 6.3 volts to the 6AB7 oscillator tube from an adjacent tube socket. Most commercial power is stable enough to make filament regulation superfluous, and the modification is quite simple. Just be sure to tape up or clip out the 17 volt lead to prevent a short circuit possibility.

The RBA covers the very low frequency range from 14.5 kc to 600 kc; the RBB covers 500 kc to 4 mc and the RBC covers 4 mc to 27 mc. Including the separate power supply they each use a total of 19 tubes.

As Fig. 1 shows, the RB- series receivers are bulky—they take up a hole 21 inches deep in a standard 19 inch-wide relay rack. With the power supply they weigh 134 pounds. Don't drop this one on your toe! The first RB- sets were made by R.C.A., but later versions up through RBA-7 and RBB-6 were manufactured by other companies, including Federal Telephone Co., at least through 1947. They cost the Navy $3,000 each, so at $45 more or less in surplus they represent a decent bargain.

The NavShips manuals on the RBA include 900,473, 900,708, and 91319. For the RBB and RBC sets the books are NavShips 900,477, 91101, 91319, and 91464.

Antenna input connectors on all of these sets use the obsolete General Radio Type 774 and rated input impedances vary from below 70 ohms to more than 1,500 ohms; the RBA is equipped with a wide-range input matching system to make the best of relatively short antennas for the long wavelengths involved. Audio outputs include a 600 ohm phone jack on the front panel and a 30 ohm output at the rear of the set.

All of the RBA-RBB-RBC sets operate off standard 117 volt 60 cycle a.c. lines except the RBC-3a, which was designed for 400 cycle power. These are quite rare in surplus; only the power supply is different from the common 60 cycle sets.

Power cables are extremely rare for these units. Generally it is necessary to replace the power sockets with octal or AN/ARC-5 type plugs and jacks and to fabricate your own cable. Fig. 2 shows the original power supply connections.

The Intermediate Frequency on the RBB and RBC is 400 kc. It may be fed to a CV-57 or similar RTTY converter either through a Navy low-impedance adapter or via a home-brew cathode follower. I have wrapped a couple dozen turns of enamel-insulated wire around the last i.f. coil to obtain low-Z i.f., signal output with no noticeable difficulties.

Sensitivity of the RB- series receivers ranges from 2.4 μv to 8.8 μv for 6 milliwatts into 600 ohms (audio output) so it is not terribly sensitive, but at its frequencies the useable sensitivity is usually limited by atmospheric noise rather than the receiver.

Fig. 3 shows a block diagram of the RBB-RBC receivers in the "modulated signal reception with a.v.c." mode.

We treated the RCK v.h.f. set in October; the RDO is somewhat similar to the RCK in size and design. Both the RCK (AN/URR-21) and the RDO are built with an integral power supply (60 cycle, 117 volts a.c.). The RDO contains a 30 mc i.f. section and an audio amplifier, a.v.c. circuits, power supply, etc., but uses plug-in r.f. heads of the AN/APR-1, APR-4 variety which can cover from 38 mc through 1,000 mc with the APR-1 heads, and up to 4,000 mc with the later APR-4 plug-ins. The NavShips book is 900,527.

I personally find the APR and RDO sets a little broad, their calibration a little sloppy, and

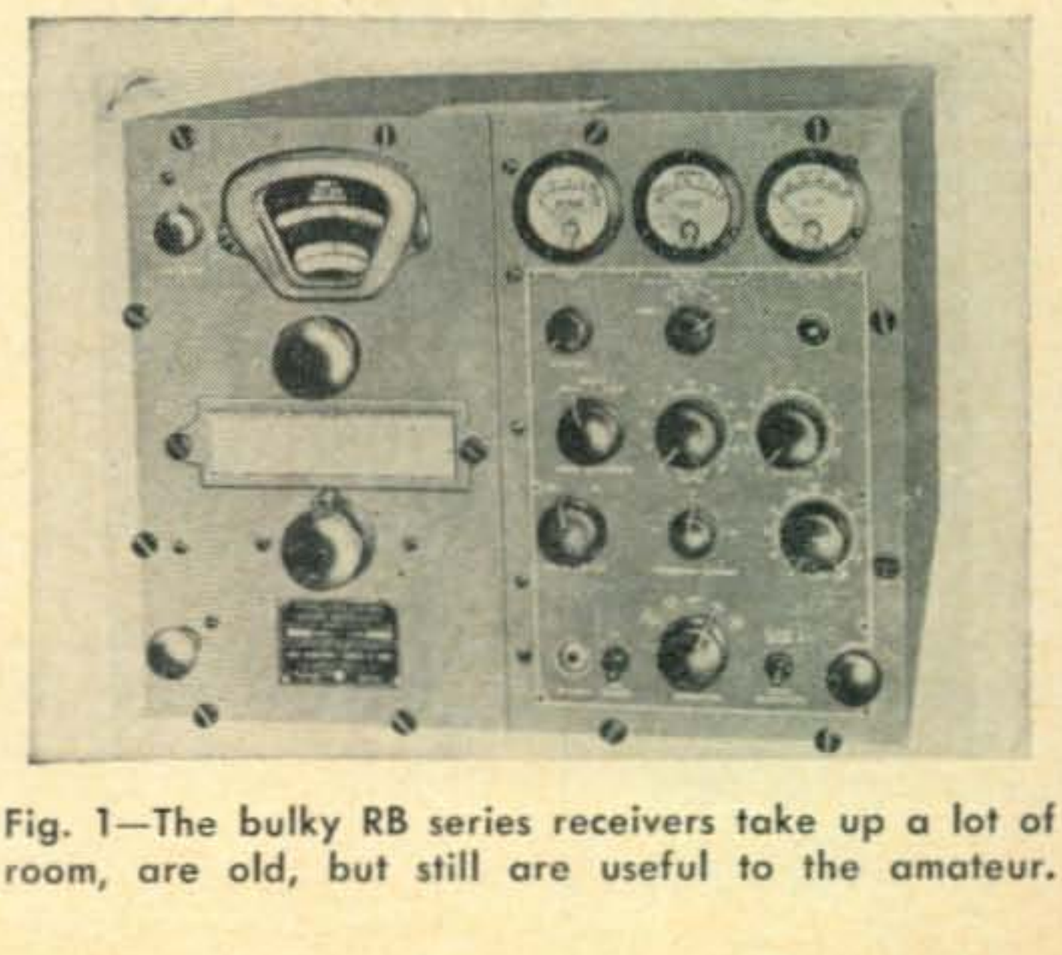

Fig. 1—The bulky RB series receivers take up a lot of room, are old, but still are useful to the amateur.

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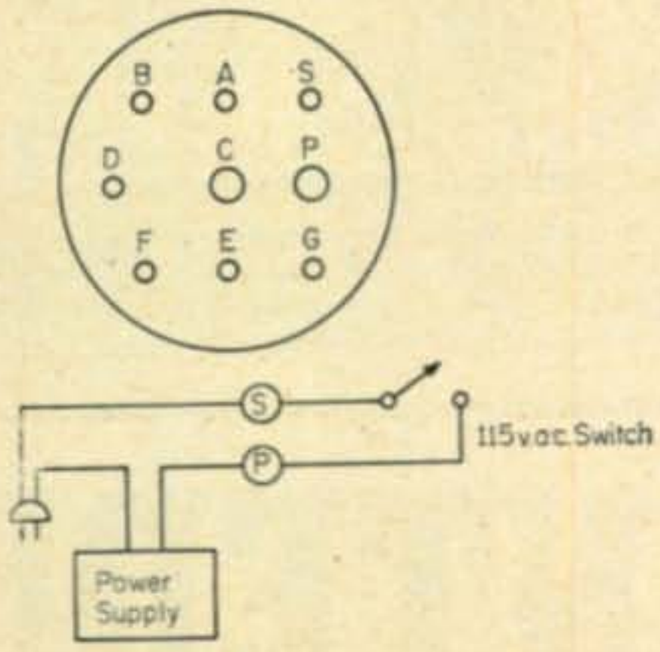


Fig. 2—The power plug connections for the RBA, RBB, and RBC receivers. (A) 17 v.a.c., (B) gnd., (C) gnd., (D) 6.3 v.a.c., (E) 105 v.d.c., (F) gnd., (G) 200 v.d.c. (S) & (P) switched 115 v.a.c.

their sensitivity a little poor for actual communications work. They are good for "listening around" over a very wide spectrum, particularly if you have the AS-989 log-periodic antenna I described in September. Their best use from my own point of view is quick tracing of oscillators. You can find harmonics and fundamentals of home-brew oscillators—and TVI—on the RDO even when the frequency is not at all where you expected to find it.

There are those who swear by the APR-RDO sets. If you hook up one of the 30 mc i.f. pan-adaptors the Navy used with these receivers you can have a very inexpensive band-watcher. Nice for impressing the neighbors.

Next month I will go into the third-generation Navy monsters, the RDZ and its updated version, the AN/URR-9. These covered the u.h.f. band 200-400 mc. These receivers are basically an extension of the RDO/RCK type, with the later rounded-corner semi-waterproof Navy-style gray cases. They weigh even more than their predecessors, in fact if Bell Labs hadn't invented transistors I suspect the Navy would have been sunk by the weight of its own electronics in a few more years.

Manuals

I have continued to scrounge here in Washington for manuals and data on sources for manuals. I am making slow headway on a compilation of technical handbooks on file at the Library of Congress, and will be able to offer a list of these sometime early next year in mimeograph form. These can only be obtained in microfilm or photocopy; the latter is quite expensive, but sometimes there is no other source.

I have turned up one gold mine of technical material on more than 1,000 items of military and commercial test equipment. This is a buy that many amateurs and engineers will want to take advantage of: 19 volumes in 11 separate books, a pile 13 inches thick of specs and data on signal generators, scopes, vtvm's, wave-guide, receivers, noise-generators, tube testers, etc. etc.

Known as the *Test Equipment Directory*, this series was compiled by Frederick Electronic Services Inc., of Wheaton, Md., under an Air Force contract. As we all have suspected, the military didn't know what it had in electronics test gear. To some extent the *T.E.D.* paralleled TM 11-487-I (test equipment) but it went further to show commercial gear used by the military services.

After your surplus editor turned up the remaining T.E.D.'s in Frederick's warehouse, Ritco Electronics bought the entire stock and is offering them at $14.95 a set, or individual books at less than $2 each. This is a real bargain for any surplus hound. Ritco can be reached through Box 156, Annandale, Virginia.

As I have done in recent columns, I want to mention another electronics company that has a reputation for being helpful to amateurs. The Stelma Corporation, 200 Henry Street, Stamford, Connecticut, produces a line of teleprinter and data terminal and metering equipment, including both complex and single-purpose units. The Stelma STM-1 set is a rack-mounted distortion monitor for RTTY circuits, and the SCI-1 is a small transistorized version of the same thing. Both have appeared in surplus channels recently. I have the books on both these units.

The SCI-1 can be installed at a Teletype Machine and used to monitor the distortion, if any, being sent.

Stelma also makes a large number of modern distortion and monitor sets currently being used by the Defense Communications Agency, and other government bureaus. The Stelma catalog is available from Mel Lipton, technical information manager. It might be of interest to amateurs and engineers working in data and RTTY. ■

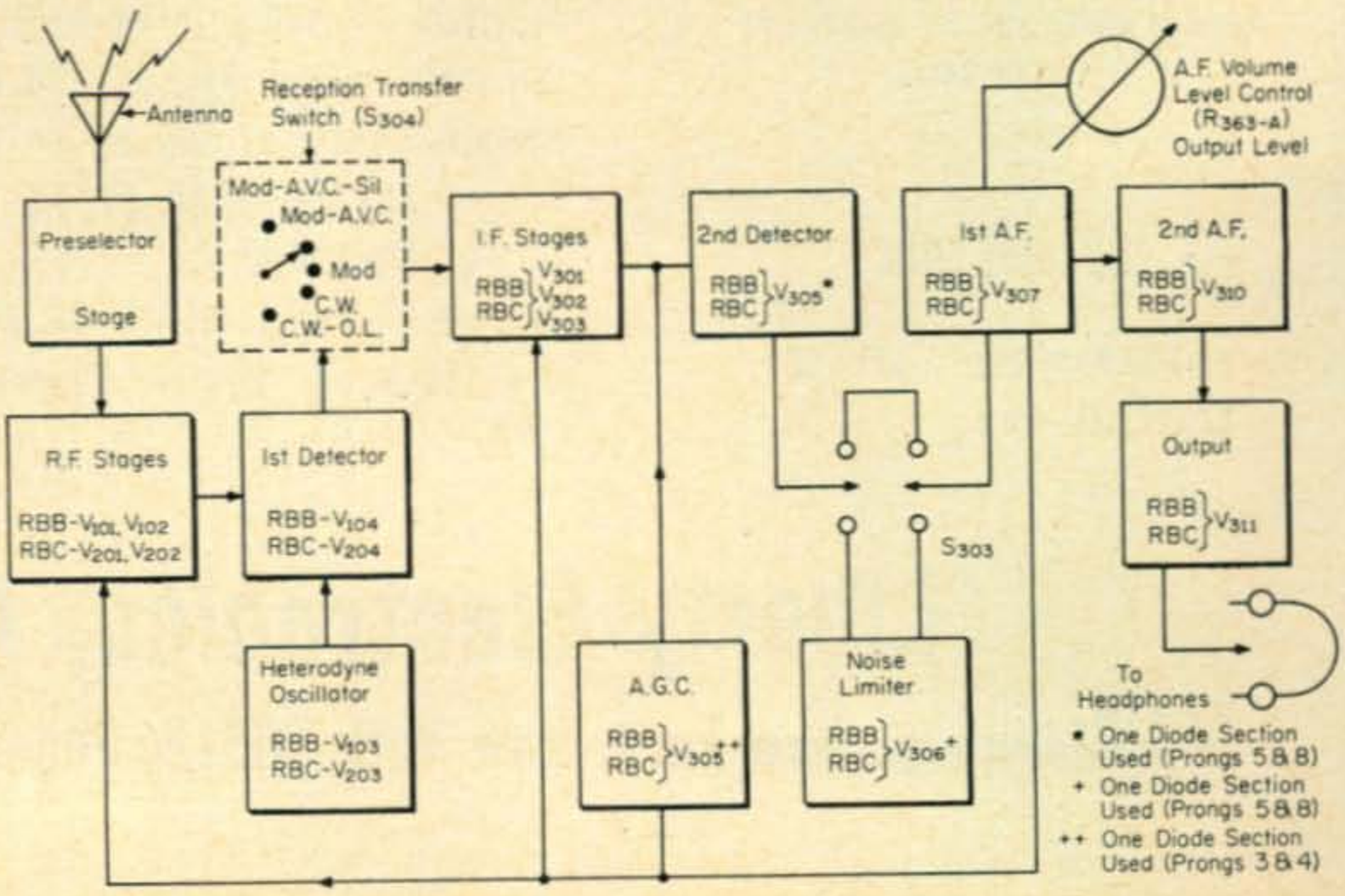


Fig. 3—A block diagram of the RBB/RBC receiver.

Phone Patch [*from page 26*]

Output of this tube is fed capacitatively into one half of the bridging transformer.

Oscillator voltage is turned on by a small relay, which is shunted across the repeating timer motor, the whole being energized whenever anything is plugged into the RECORD jack on the front panel. Considerable filtering was required in the input to the oscillator, to keep the tonel from feeding back into other circuits. Key clicks were minimized by leaving the oscillator circuit energized as long as something was plugged into the RECORD jack, and keying by unshortening the output.

Power Supply

For good operation, the power supply of this phone patch can be almost anything that will give the requisite filament and plate voltages, which are 6.3 volts at about 2 amps, and 150 or more volts d.c. at about 100 ma. For optimum operation, which means a minimum of hum, and insensitivity to power line surges, the filaments should be biased positively with respect to ground, and the plate voltages should be regulated.

Circuit of the power supply used with this phone patch is shown in fig. 3. Silicon rectifiers are used to reduce heat, and a zener diode provides voltage regulation. The capacitors across the power transformer windings are to absorb power line transients. Filter capacitors are socket-mounted to facilitate testing and replacement. The 10 ohm resistor in series with the pilot lamp reduces its brilliance slightly, and extends lamp life by a factor of more than three.

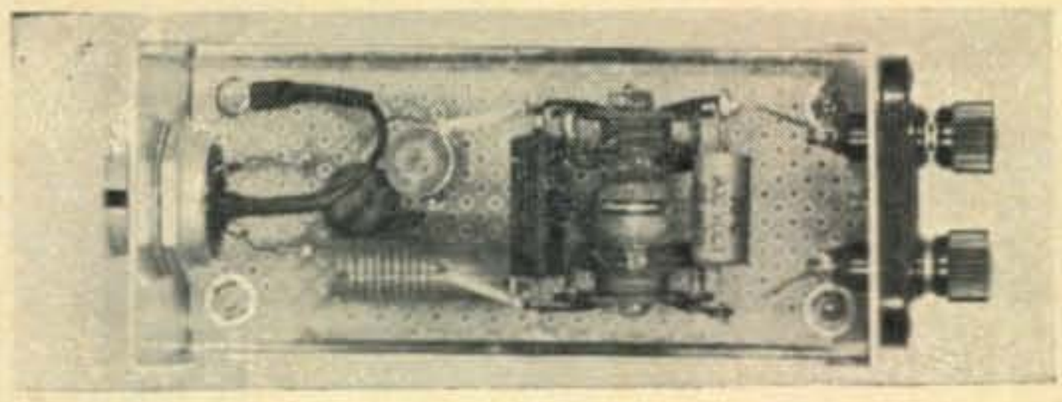
Construction

The phone patch was built on a 10" × 13" × 2" chassis (Seezak), with a 5¼" × 12" front panel. This fitted the available rack space, and permitted construction without use of special tools or "packing factor" problems. The exact format is not critical, and may be varied within wide limits to fit the space available and the user's taste.

Dependable operation is obtained by careful attention to mechanical ruggedness and electrical margins of safety. The chassis is firmly held to the panel with brackets, and tie points are used liberally, not only to hold components in place, but to provide adequate test points.

Input and output leads are run in shielded microphone cable to minimize intercoupling; filament and other a.c. leads are twisted, to reduce external fields. Tube shields are used over all tubes to serve as thermal hold-downs, so that the tubes will not eventually work their way out of the sockets.

The MONITOR LEVEL control, which is adjustable from the front panel, is mounted in mid-chassis, and mechanically connected to the control knob by a length of flexible shafting. As this control needs only occasional setting, a shaft lock (Millen 10062-T) is provided under the knob.



Interior view of the r.f. filter.

The beeper frequency control, on the rear chassis skirt, is similarly equipped. Input and output jacks are provided with "toilet seat" jack covers to keep dust, insects and bobby pins out of the chassis interior. The line plugs are provided with screw caps to inhibit unwanted connections.

Adjustment

After a preliminary smoke test, and correction of any wiring errors disclosed thereby, connect power to the phone patch. Turn it on, connect a steady tone (such as 1,000 cycles) to the input, and shunt 600 ohms across the line plug (pins 2 and 3). Throw the line switch to OUTGOING LINE, set the OUTPUT LEVEL control to center scale, and turn the INPUT LEVEL control to top mark. Adjust the first attenuator until the output meter reads 0 v.u.

Now, back off the INPUT LEVEL control until the indicated output just begins to drop. This is the point where limiting begins. With this setting, retouch the first attenuator, if necessary, to return the indicated output to 0 v.u. with the OUTPUT LEVEL set at center scale.

Next, switch the meter to CHECK BALANCE position, set the *L* and *C* controls of the balancing network to zero resistance, and adjust the *R* control until the meter reading is a minimum. This gives a preliminary line balance.

Set the INPUT LEVEL to zero, lift one lug from the microswitch of the beeper timer, and insert a plug (with nothing connected to it) into the RECORD jack. Adjust the beeper oscillator frequency to about 1400 cycles, and set the beeper volume to about −1 v.u. (This is the average level for speech in many instances). Reconnect the microswitch of the timer, check the timing interval (one "make" each 15 seconds), and adjust the beep duration to about ⅕ second. When this is satisfactory, remove the plug from the RECORD jack.

Now the phone patch is ready for an "on line" test and final balancing. With power on, a sine wave input, and an input level adjusted to just about the beginning of limiting, set the line switch to center position. Remove the 600 ohm resistor from the line plug, and connect the line plug, through the r.f. filter, to the two hot wires of the phone line.

Make a local call to a patient friend, explain what is going on, and switch the patch onto the line (line switch in OUTGOING LINE position). Adjust output level until the meter reads 0 v.u., then switch to CHECK BALANCE position, and read balance on meter. The reading should be low. Readjust the *R* and *C* controls of the balancing network for an even lower reading, then reduce

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it still further by adjusting the *L* control. As these controls interlock somewhat, the best null will be arrived at by successive approximations. Final adjustment is best done by plugging a scope into the OUTPUT position, as the attainable null gives almost no reading on the v.u. meter.

When the best possible null is obtained, recheck by replacing the sine wave input to the patch by a voice signal, and note the results. With the equipment used, and any ordinarily good phone line, the null obtained with a sine wave input will be about —40 d.bm, plus or minus 5 db. With a voice signal, null depth will be about 10 db less, the exact difference will depend upon the amount of limiting used and the speaker's voice pattern.

The null obtained on a long distance circuit will not be exactly the same as that on a local circuit, but, with the resistive pad between the hybrid transformer and the line, this difference is not likely to cause any trouble with vox operation, and the unwanted signal, under worst conditions, is not likely to exceed —20 d.bm.

Performance

This phone patch works consistently and well, somewhat outperforming two commercially made phone patches, and providing monitoring and recording conveniences not included in the commercial devices. Frequency characteristics are ideal for male voices speaking American English, and are workable, although not ideal, for female voices, and for most western European languages.

The monitoring feature makes possible continuous "riding of gain," adjustment of limiting for ambient conditions, and insertion of fill-ins and translations when that is desirable or necessary. The recording feature is most helpful at times, and the beeper prevents any possibility of trouble from the recording feature. ■

Priscilla Paris [*from page 32*]

She has a 2-meter rig and is hoping to build other gear, though her busy schedule leaves little time for it.

Originally residents of the San Francisco Bay area, the Paris Sisters—Albeth, Sherrell and Priscilla, and all "real sisters—moved to Los Angeles to be near the center of the entertainment world. Priscilla has been in the entertainment field since she was four years old and during the past fifteen years the girls have toured most of the world and have entertained in night clubs, on TV and at military bases.

The Paris Sisters have made many hit records, among them "I Love How You Love Me" (which earned them a Gold Record) and "Soldier Boy." They are currently making records for "Reprise." They are under contract to MGM which will develop television and motion picture properties for the girls as well. They are doing a TV series entitled "The Glass House," and have appeared with such TV stars as Red Skelton, Dinah Shore, Jack Paar, Arthur Godfrey, Roy Rogers, Steve Allen, Arthur Murray, Ed Sullivan, etc. Supper clubs where they have entertained include Harrahs at Lake Tahoe; The Roosevelt, New Orleans; The Dunes, Flamingo, Tropicana and Sands at Las Vegas; and world-wide spots like The Copa and The Latin Quarter in Tokyo, and El Patio in Mexico City.

Young, talented and beautiful, these girls are a favorite with servicemen at bases around the world, and most recently in Viet Nam. Such appearances are no novelty to Priscilla and her sisters for as pre-teenagers they performed for many military camp shows around San Francisco.

WN6RNR not only stars as a singer, but she also plays guitar and writes songs, many of which she and her sisters have presented in supper clubs and on TV appearances.

Good luck to you, Priscilla—we're hoping you'll make that General soon and continue on the air as an amateur operator as well as a successful, professional star! ■

CQ Reviews the TR-106 [*from page 53*]

The V-107 is styled to match the TR-106 Transceiver. Its size is 5½" × 4⅝" × 6½" (H.W.D.)

The Knight-Kit TR-106 6-Meter Transceiver is priced at $139.95 (kit), including preassembled and aligned front-end converter, all necessary parts, noise-canceling p.t.t. microphone, assembly and operating manuals. The latter, by the way, includes interesting data on TVI traps, a.c. power line filters, R/C filter for BCI, mobile noise suppression, etc. The TR-108 2-Meter Transceiver kit is $144.95, equipped as above. The V-107 v.f.o. kit is $19.95. Crystals are not furnished with the kits but are available at $2.95 each. Other accessories are a mobile mount at $7.50 and a base on which to mount the v.f.o and a transceiver together for desk-top use, priced at $6.95. These products are marketed by Allied Radio Corp. 100 N. Western Ave., Chicago, Ill. 60680. ■

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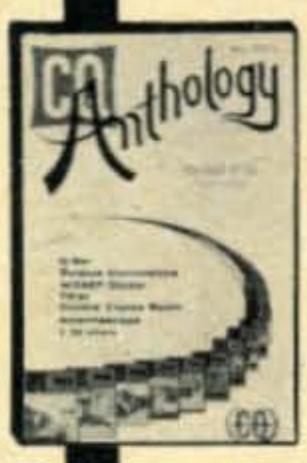

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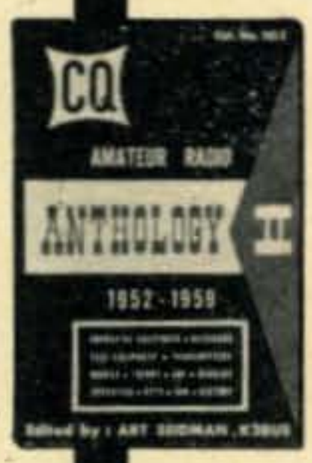

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The LR-1 [*from page 28*]

Generating Audio Frequencies

Audio frequencies in the range of 0 to 5.5 kc can be derived from the calibration oscillator and the H.F.M. Place the CALIBRATOR switch in the 20 kc position. Place the H.F.M. in range 1 (160 to 232 kc). Place the DETECTOR INPUT switch in the MEASURE position. With the interpolator test switch in the lower position adjust the H.F.M. frequency control to zero beat with any harmonic of the calibration oscillator near the middle of the band. Advance the H.F.M. frequency control and read the audio frequency from the lower scale of M_{101}. The audio output is obtained from the telephone jacks J_{101} or J_{102}. ■

20 Meter Yagi [*from page 78*]

most complicated detail of the yagi assembly, it is still a relatively simple task. Any medium spaced capacitor with about 100mmf value will work well. It is important, however, that the rotor plates have a full 360 degree motion and the capacitor circular motion have only the slightest degree of drag. In the original installation, an old ARC-5 tuning capacitor with several plates removed worked perfectly. Since the capacitor is series installed it is important that the unit be insulated above the boom ground potential as well as being insulated from the synchronous motor. The capacitor frame is placed on a sheet of polystyrene and the shaft series insulated from the motor shaft with a short length of dowel or a flexible coupling and fibre shafts. If dowel is used each dowel-end is drilled with the proper diameter bit in order to slip snugly onto the respective shafts. A small amount of Duco cement more than adequately secures the units.

The synchronous motor is the standard 110 v.a.c. unit with about 1-2 r.p.m. The rather slow movement will allow for an accurate determination of the lowest s.w.r.

The input end of the circuit can either utilize a standard coaxial connector or a porcelain feedthrough insulator. Neither one offers any particular advantage. The gamma matching rod is soldered to the center of the mating PL-259 connector. *No connection* is made to the shell of the plug. Use an insulated length of #12 or #10 copper wire terminated 42" from the driven element center for the 50 ohm terminus along the element length. All internal Minibox connections are made with a similar gauge. Simply solder one lead to the stator and the other lead to the rotor section.

For the gamma rod support, a 1×6" length of polystyrene is fastened on the driven element about midway along the gamma rod's length. A small (1") clamp secures the support and insulator. At the other end drill a small hole and tie the rod to the insulator with a small piece of twine. At the far end of the gamma rod (42" point) bend a length of copper sheeting around the terminus point and secure with a nut and bolt. At the far end of the sheeting (6") solder the gamma rod to the copper stock to complete the installation. These details are shown in fig. 2.

The extra length boom presents a support problem; consequently, the need for a length of nylon rope support. About midway along the length of the boom extensions secure a clamp for the support tie point and install a turnbuckle for any subsequent sag adjustments. A mast extension of about 3-4' is adequate.

Final Adjustment

Coat all joints with Krylon spray to assure a continuation of low resistance inter-element conductivity and a consistent impedance load. Make all final measurements with the antenna at its normal operating height. Connect power to energize the motor-capacitor drive. For those with a remote rotor installation, remove two wires from the rotor cable at the tower and jump them to the drive motor. Remove the same two wires (follow color code) at the control panel. Remember the rotor is now inoperative but it does eliminate the burden of stringing a temporary line. Experience has shown the antenna to reflect a rather constant input characteristic, so a permanent line to the synchronous motor is not really an absolute necessity. The amateur can either adjust the system for maximum signal detection (from a known and stable source using an S-meter) or simply concentrate on the lowest s.w.r. value. Expect a ratio of 1.5:1 or less and a front-to-back ratio in excess of 35 db with a properly tuned unit at a moderate height.

Every care has been taken to insure an inexpensive yet rugged antenna system comparable to the finest commercial counterparts. Even in the extreme cases of low antenna heights and adjacent power absorbing obstacles, the system will cancel out the reactance factor and produce a signal worthy of the serious amateur antenna builder. ■

Radio Club [*from page 17*]

visitors applying for foreign membership are required to pay a "small cup round table". This means the purchase of a small cup of coffee for each member present at the meeting where the applicant is introduced. The cost usually amounts to about $2.

Radio amateurs visiting Helsinki are cordially invited to attend the daily meetings of the Café de Colombia Radio Club, and take part in the club's activities. This is an excellent opportunity to enjoy luncheon with members of the world's most active radio club. Radio amateurs interested in becoming members of the Club, can obtain additional information as well as a list of present members from: Café de Colombia Radio Club c/o SRAL, Box 10306 Helsinki 10, Finland. ■

Transistorized Converters [*from page 40*]

recovery computer diodes make even better multipliers, usually with lower resistor values than the 82K value shown in fig. 4. This resistor can

be connected directly to ground as shown or across the coupling capacitor. This coupling capacitor can be varied from 5 to 20 mmf and a fixed unit of optimum value substituted since these are less bulky in space requirements.

Alignment

Any of these converters can be aligned on received signals but a v.h.f. signal generator and diode noise generator are a definite help in proper alignment. The oscillator, when functioning, always produces a noticeable noise increase in the i.f. receiver output. Once oscillation is present, all circuits should be peaked up for best n.f. and weak signal reception. ■

A.M. For SB-110 [*from page 13*]

Before going on the air with normal s.s.b. operation, another initial adjustment should be made. *Push in* the A.M. knob and readjust the s.s.b. CARRIER-NULL control according to the manual instructions. Once set, the CARRIER-LEVEL control for a.m. and the CARRIER-NULL control for s.s.b. should seldom require readjustment.

Initial receiver realignment also should be made by adjusting T_3 as indicated in step 5 on page 88 of the manual.

Theory of Operation

Referring to fig. 1: with the switch set at the A.M. position and during transmit, the output of the carrier generator goes to the A.M. CARRIER-LEVEL control to provide a carrier (at half the maximum normal tuneup-output level) injected at the 1st i.f. amplifier, V_{4A}, following the sideband filter. On receive, B plus is applied to the diode switch, CR_1, which grounds the output of the carrier generator and removes this signal from the CARRIER-LEVEL control and V_{4A}. At the same time, the switch connects the output of the envelope detector to the A.F. GAIN control.

A small size coupling capacitor (0.001 mf) at the output of the detector is used to reduce the low-frequency a.f. response and thus minimize a "muddy-sounding" a.m. signal caused by the narrow bandwith of the sideband filter.

With the new switch at the S.S.B. position during transmit, the CARRIER-LEVEL control is disconnected from the carrier generator and is grounded to prevent carrier leakage through V_{4A}. At the same time, the receiver A.F. GAIN control is disconnected from the envelope detector and is connected to the product detector via the 1st a.f. amplifier. ■

30 Again [*from page 15*]

as it was the standard code for wire telegraphy on the continent of Europe). All *radio* telegraph communication controlled by the United States would henceforth use the characters of the International code. Look at what happened to "30"; in the International code; it became, "dit dit dit dah dah—dah dah dah dah dah." Try to say *that* one fast and make it sound rhythmic! To make the same characters as the old Morse "30", in International code, came out as the *letters* "SK"

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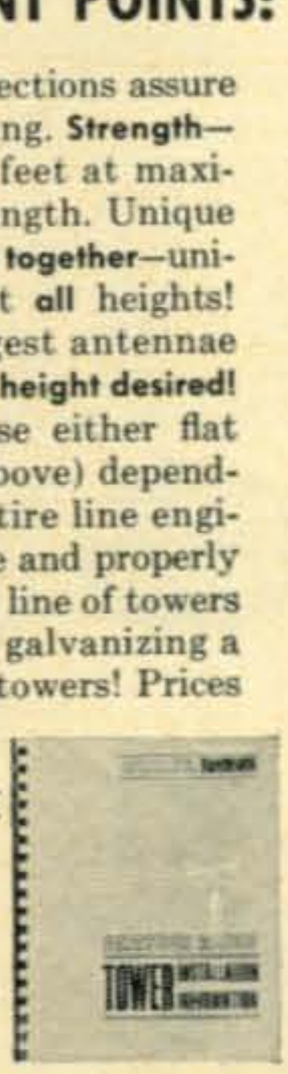

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(• • • — • —) which when run together had identically the same rythmic sound as the Morse "30" particularly when the operator dragged the last dash of the K a bit which most of them habitually did. And believe it or not, the U.S. Government showed a bit of sentiment and recognized the well-established tradition by specifying the code combination of "SK" as the official finish signal for conclusion of a radio communication! Proof? Witness the last page of the official publication of the Department of Commerce, Bureau of Navigation, Radio Service, *Radio Stations of The United States*. Titled, "International Morse Code And Conventional Signals" the last entry in the lower right hand corner of the page reads as follows: "Transmission finished (end of work) conclusion of correspondence • • • — • —"! Good old "30" was here to stay . . . legally!

Radio operators never refer to the finish signal as "30" however; it is always spoken of as "SK" and is now internationally accepted as the conclusion sign not only in commercial radio telegraph communication but it is also recognized the world over by the amateur radio telegraph fraternity. A few broadcast station announcers still cling to the old Morse designation of "30" however; you know, "Well, thats' "30" for tonight folks—ABCD is now signing off."

Perhaps *CQ* and other periodicals catering to the amateur radio field should get more in line and give consideration to what is exclusively a *radio* telegraph expression and use '——SK——' for their breakhead; who will be first? ■

DU1GSP [*from page 80*]

an evening session and attends advance studies in graduate school for an hour each evening. Then there is always the lesson planning, researching and meetings to attend.

There are several other YLs in the Philippines. DU1AJ, Aleli Jose, first trustee of DU1GSP, is also a commercial radio operator and now is with Young Christian Workers. Another YL is Mrs. Alice Borneo, with Civil Defense in Davao City. Elfrida Aristorenas, harmonic of DU1FB, a nursing student, goes on the air in her father's shack. There are two other YLs, harmonics of active DX'ers—Susan Hashim of DU1EH and Terry Nolasco of DU1MBN, and Liz Lopez, sister of DU1CL is working at it.

Congratulations to you, Frances, on your accomplishments, and all best wishes to you in your program to train more YL operators in the Philippines! ■

Frequency Standard [*from page 61*]

input pulses, transistor Q_2 is cut off. Q_3 conducts because its base is connected through 60K to the supply voltage. Q_2 is not cut off completely but only leakage current flows.

When a positive input pulse is fed into the base of Q_3 it cuts-off almost immediately. The sudden change in the collector voltage of Q_3 due to the input pulse, turns Q_2 "on". The input pulse can return to zero but Q_2 and Q_3 remain in

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their switched states for a time determined by the time constant of the 0.002 mf capacitor connected between Q_2 and Q_3, and R, the 60K resistance. After this period of time, the transistors switch to their original states. This action is similar to the action of a door that is connected to a door closer. The door may be suddenly opened, but it always returns to its closed position.

To obtain 10 kc from a 100 kc source, the "on" time of Q_3 should lie somewhere *between* 90 and 100 microseconds. Ninety-five microseconds was the nominal length chosen for this Standard. (This explains the overlapping range of adjustment of R_1.) Because the pulse length can vary 5 microseconds in either direction, the circuit has a tolerance to voltage and temperature shifts.

Figure 2 shows the input and output waveforms of the one-shot multivibrator. Because the output pulse is only 5 microseconds wide, the harmonic content is high.

Referring again to fig. 1, there is no switching at the output connector when changing from 100 to 10 kc. The 100 kc signal feeds through the "dead" monostable multivibrator. The 100 kc and the 10 kc harmonics have nearly the same relative amplitude throughout the high frequency range. ■

USA-CA [*from page 94*]

for 100, 200 and etc. Also a yearly contest in which the top-scoring station and s.w.l. in each continent receives a special award, (also the U.K. Champion & s.w.l.). The World Champion station & s.w.l. will each receive a Silver Cup. The 18-page *Directory-Of-Islands* lists all the islands and island groups which count for IOTA and full information on the awards and yearly contest. Cost of directory is 4 IRCs.

Notes

I noticed in the newspapers today that the firm of M. L. P. F. & S. (mentioned in the story about Pappy, WA9AJF) turned over a check for over a half *billion* dollars to Howard Hughes for his TWA stock. Sorry, no commission for Pappy.

An additional note from Mal, K4RIN to explain that he will have stations set up at his own QTH and at home of his parents, and he will continue to operate from both spots for an indefinite period.

A letter just received from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 stating that POD 26 has not been discontinued and is now available for $2.75.

Again many thanks for ALL your kind cooperation and help. How was your month?

73, Ed., W2GT.

Condensers [*from page 48*]

but by putting all of the E's on one side, and all of the straight pieces on the other; the spacing material then goes between the end of the E and the straight piece. Then clamp together.

Beware of short circuits from winding to frame in old transformers; they can be dangerous. When an electrostatic shield is fitted between primary and secondary windings, it is definitely desirable to ground it (if not done already), to reduce leakage and noise. If you see an extra wire which seems to be connected to nothing else, it is probably the electrostatic shield.

Finally, if you have a modern high temperature transformer, and choose to run it hot (RLG's protestations notwithstanding), don't forget to consider the effect of the heat on nearby temperature sensitive components, eg, transistors, diodes, thermistors. ■

"HAM" BUERGER, INC.

our new address: 424 York Road
Jenkintown, Pa. 19046
Phone: 224-1740; 887-7350
In New Jersey: 963-2100

QRNews

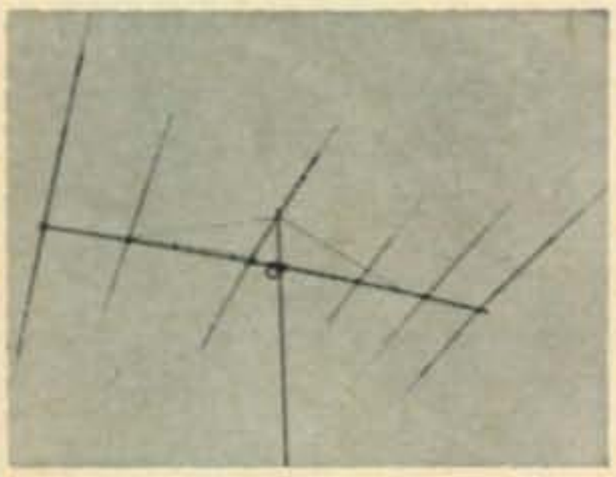
This month's best buys — HY-GAIN

ELECTRICAL SPECIFICATIONS:

Frequency Range
20, 15 and 10 Meters
Gain .....8.7db (average)
Front-to-Back Ratio 25db
Maximum Power Input
1 kw AM; 2 kw P.E.P.
VSWR (at resonance) ...1.5:1
Impedance .....50 ohms

MECHANICAL SPECIFICATIONS:

Longest Element .....32 ft.
Boom Length .....24 ft.
Turning Radius .....20 ft.
Net Weight .....47 lbs.
Maximum Wind Survival
100 mph
Mast Diameter .....1⅝"
Boom Diameter .....2"



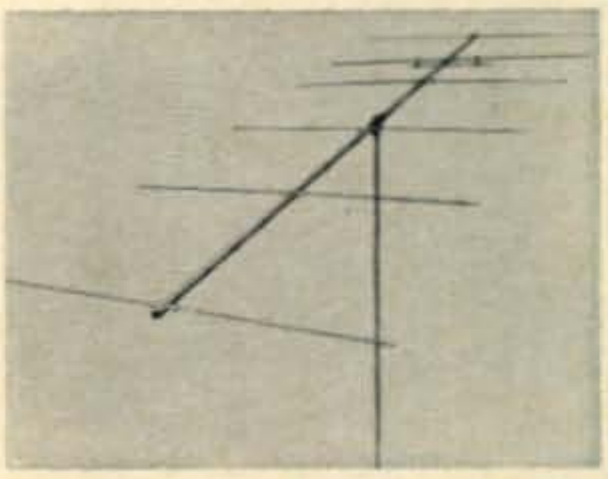
TH-6DX $149.95

ELECTRICAL SPECIFICATIONS:

Gain 15db
Front-to-Back Ratio ..20-25db
Maximum Power Input ..1 KW
VSWR (at resonance) ...1.5:1
Impedance .....52 ohms
Uni-directional Pattern

MECHANICAL SPECIFICATIONS:

Longest Element .....9'9"
Boom Length .....24 ft.
Turning Radius .....12'6"
Net Weight .....17 lbs.
Maximum Wind Survival
100 mph
Mast Diameter .....1⅝" OD
Boom Diameter .....1¼" OD



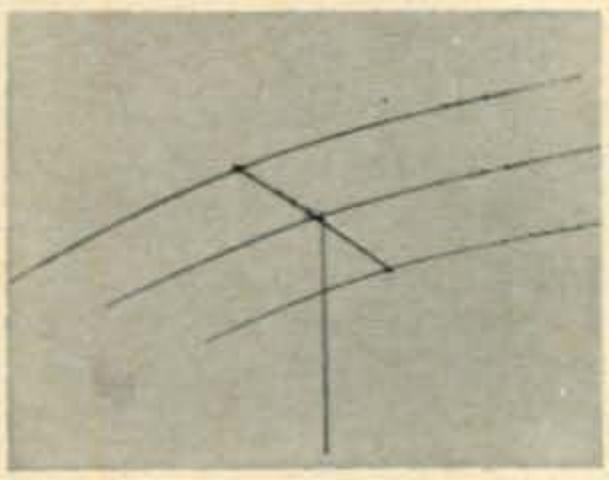
66B $38.50

ELECTRICAL SPECIFICATIONS:

Gain 8db
Front-to-Back Ratio 25db
Maximum Power Input 300
Watts AM; 600 Watts PEP
VSWR (at resonance)
Less than 2:1
Impedance .....52 ohms

MECHANICAL SPECIFICATIONS:

Longest Element .....26 ft.
Boom Length .....12 ft.
Turning Radius .....14.3 ft.
Net Weight .....21 lbs.
Maximum Wind Survival
80 mph
Mast Diameter ...1¼ to 1⅝"
Boom Diameter .....1¼"



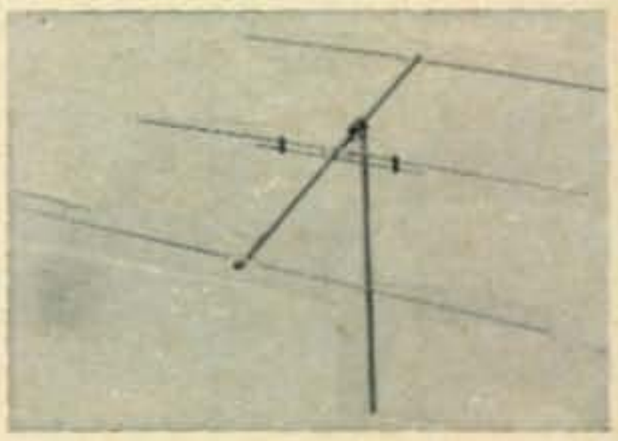
TH-3 Jr. $74.95

ELECTRICAL SPECIFICATIONS:

Gain 10db
Front-to-Back Ratio ..20-25db
Maximum Power Input ..1 KW
VSWR (at resonance) ...1.5:1
Impedance .....52 ohms
Uni-directional Pattern

MECHANICAL SPECIFICATIONS:

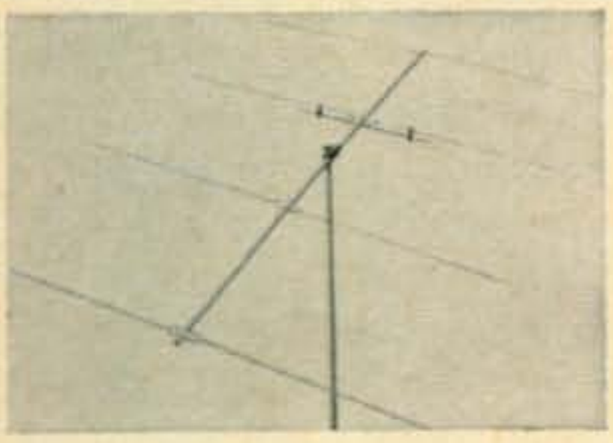
Longest Element .....9'10"
Boom Length .....8 ft.
Turning Radius .....6 ft.
Net Weight .....5 lbs.
Maximum Wind Survival
100 mph
Mast Diameter
1¼" to 1⅝" OD
Boom Diameter .....1¼" OD



63B $18.95

ELECTRICAL SPECIFICATIONS:

Gain 12.7db
Front-to-Back Ratio ..20-25db
Maximum Power Input ..1 KW
VSWR (at resonance) ...1.5:1
Impedance .....52 ohms
Uni-directional pattern



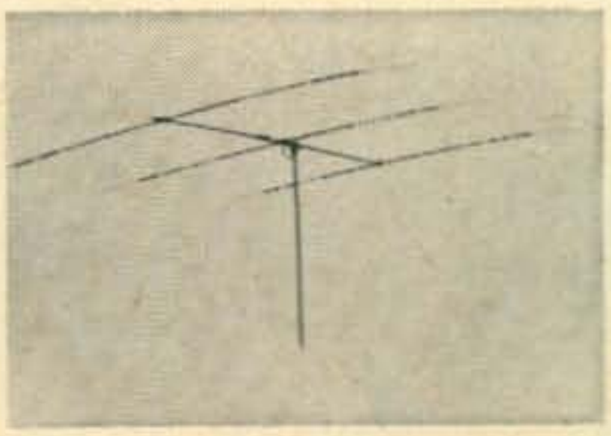
64B $24.50

MECHANICAL SPECIFICATIONS:

Longest Element .....9'11"
Boom Length .....12 ft.
Turning Radius .....8 lbs.
Net Weight .....8 lbs.
Maximum Wind Survival
100 mph
Mast Diameter
1¼" to 1⅝" OD
Boom Diameter .....1¼" OD

ELECTRICAL SPECIFICATIONS:

Gain 8db
Front-to-Back Ratio 25db
Maximum Power Input
1 KW, AM
VSWR (at resonance)
Less than 2:1
Impedance .....52 ohms



TH3Mk2 $114.00

MECHANICAL SPECIFICATIONS:

Longest Element .....28 ft.
Boom Length .....14 ft.
Turning Radius .....15.7 ft.
Net Weight .....36 lbs.
Maximum Wind Survival
100 mph
Mast Diameter .....1⅝"
Boom Diameter .....2"

For further information, check number 18, on page 110

"HAM" BUERGER, INC.

QRNews

our new address: 424 York Road
Jenkintown, Pa. 19046
Phone: 224-1740; 887-7350
In New Jersey: 963-2100

"HAM" BUERGER'S

RECONDITIONED EQUIPMENT

HALLICRAFTER

SX122/W CAL.	$245.00
HA6/P26	135.00
SX110	115.00
R48	12.50
SX110	109.95
HT40	59.95
HT37	275.00
SX101	199.00
HA5	59.95
SX100	135.00

EICO

377	$ 34.95

POLYCOM

6 Meter	$199.00

DRAKE

TR4/AC3	$499.95

WRL

Galaxy 2KW	$289.00
Globe Scout 65A	34.95
Globe Chief	44.95
UM 1 Modulator	24.95
Globe Scout 66	35.00
Globe Champion	125.00

HAMMARLUND

HQ110A	$185.00
HQ170C	195.00
HQ110C/SPKR	149.00
HQ110	125.00

CLEGG

Thor 6	$319.00

RME

DB23	$ 29.95

HEATH

HG10	$ 24.95
DX60	79.95
Apache	149.95
Seneca	144.95
DX60	64.95
Apache/SB10	225.00
GR91	39.95
DX40	44.95
DX100	99.95
QF1	8.95
Sixer	42.50
1G52	49.95

NATIONAL

NC303/CAL	$249.00
NC188/SPKR/QF1	79.95
NC125	79.95
6-2VFO	39.95

KNIGHT

R100A	$ 64.95
R100	65.00
Star Roamer	29.95

COLLINS

75A2/3	$250.00
754A	400.00
100 Watt Dummy Load	35.00

JOHNSON

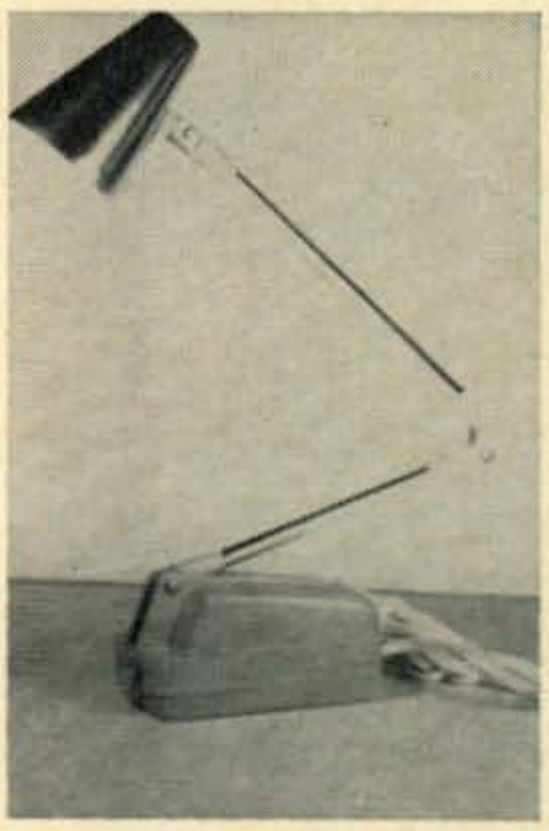
Challenger	$ 74.95
Challenger	74.95
Challenger	74.95
Ranger II	225.00
Valiant I	249.95

LAFAYETTE

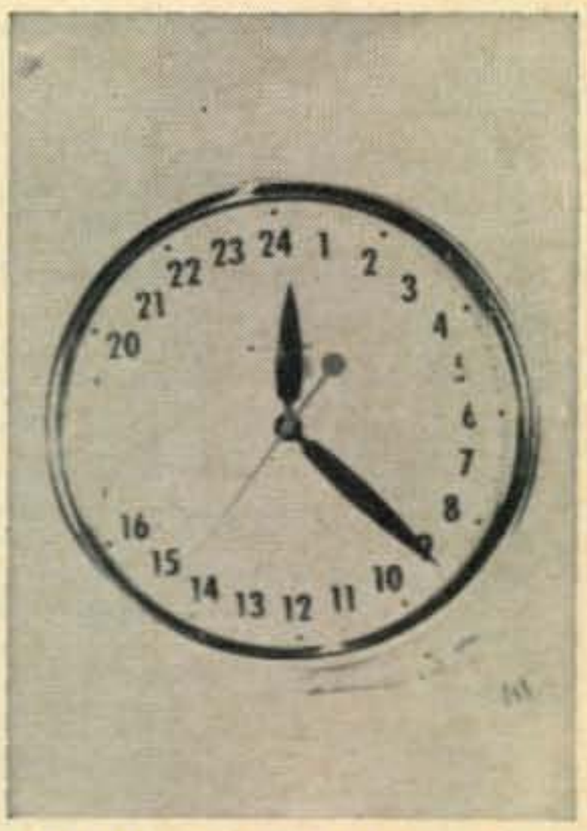
HE10	$ 59.95
HA230/QF1	74.95

ASTATIC JT-30 Crystal Mike reg. price $18.40 SPECIAL $6.99

ASTATIC GD-104 PTT Mike reg. price $51.00 SPECIAL $25.00



Minilamp Hi intensity station lamp. Tan base, brass shade. Adjustable $5.95



MASTERCRAFTER CLOCK 2324 Chrome 24 hour clock $9.95

UTICA 650A complete with ceramic Mic. VFO. Full Warranty $149.90

For further information, check number 19, on page 110

LOOK...NO HOLES!

FITS ANY C.B. OR HAM ANTENNA

THIS RIGID RUSTPROOF ANODIZED ALUMINUM ANTENNA MOUNT FASTENS TO YOUR CAR TRUNK LID IN MINUTES . . . AND NO BODY HOLES ARE NECESSARY!

SEE THESE SUPERIOR MOUNTS AT YOUR DISTRIBUTOR/DEALER OR REMIT $8.95 (check or M.O.) TO E-Z MOBILE ANTENNA MOUNT INC., P.O. BOX 277, ALGONAC, MICHIGAN (Michigan residents add 4% sales tax) PHONE 313 794-7343

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DEALER INQUIRIES INVITED

E-Z MOBILE ANTENNA MOUNT

PATENT PENDING

For further information, check number 30, on page 110

SUB CARRIER DETECTOR

Add programs of commercial-free music thru your FM tuner. Detector, self-powered, plugs into multiplex output of tuner or easily wired into discriminator and permits reception of famous background music programs now transmitted as hidden programs on the FM broadcast band from coast to coast. Use with ANY FM tuner.

WIRED UNIT $75.00
KIT, with pretuned coils, no alignment necessary $49.50
Covers extra $4.95 each. Current list of FM Broadcast Stations with SCA authorization $1.00

MUSIC ASSOCIATED
65 Glenwood Road • Upper Montclair, New Jersey
phone 744-3387 area code 201

For further information, check number 31, on page 110

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PIONEER ELECTRONICS SCHOOL

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INDUSTRIAL ELECTRONICS

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75-40-20-15-10 meter bands. Complete **$19.95**
40-20-15-10 meter. 54-ft. (best for swl's. Complete **18.95**

SEND ONLY $3.00 (cash, ck., mo) and pay postman balance COD plus postage on arrival or send full price for postpaid delivery.

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HUNDRED QSL's—$1.00. Samples, dime. Holland, R3, Box 649, Duluth, Minn. 55803.

QSL's, Quality printing, samples Dime, refundable, Johnson, Box 245, St. Paul, Minn.

QSL's 3-color glossy. Rutgers Vari-typing Service. Free Samples, Thomas Street, Riegel Ridge, Milford, New Jersey 08848.

SPECIAL K2HVN QSL designs for mobilers and many others. Samples 25¢. 860 Atlantic Street, Lindenhurst, New York.

CB, SWL, QSL, WPE Cards $7.50 per 1,000! Free samples. ABCD Printing, P.O. Box 658, Edgewater, Cleveland, Ohio, 44107.

RUBBER STAMPS $1.15. Postage and tax included, call, address and zip. Clint's Radio Service, 32 Cumberland Avenue, Verona, New Jersey.

SAVE ON ALL NEW OR USED HAM GEAR. Call or write BOB GRIMES, 89 Aspen Road, Swampscott, Mass. 617-598-9700.

WRL's Bluebook saves money. These prices without trades, cash or charge: HT32—$251.10; HT37—$233.10; HT40—$49.45; SX99—$85.05; HX20—$134.10; KWM1—$224.10; PMR8—$71.95; AF68—$71.95; King 500A—$206.10; HQ170C—$179.10; Ranger 1—$89.95; Valiant I—$152.10; Galaxy 300—$161.10; hundreds more—free list. WRL, Box 99, Council Bluffs, Iowa 51501.

COLORADO HAM DIRECTORY now available. Over 3,700 current listings. $2.00. Denver Radio Club, Box 356, Denver, Colorado 80203.

WANTED: Military, Commercial, SURPLUS. Airborne, Ground, Transmitters, Receivers, Testsets, Accessories. Especially Collins . . . We pay Cash and Freight. RITCO, Box 156, Annandale, Virginia (703)-560-5480 COLLECT.

COLLINS telescopic antenna, HF 120' extended height, model #237Q-2A, freq. range 2-30 MC, 50 ohm, omni directional radiation pattern, blast protected, shock insulated. Gov't. surplus, from Atlas "F" missile sites . . . like new! (10) available. First come, first served! Perry Equipment Corp., 1421 N. 6th St., Phila., Pa. 19122.

STAINLESS STEEL Hardware. Small quantities. Send S.A.S.E. for list. ARLINGTON STAINLESS, Section A, Box 2641, Baltimore, Maryland 21215.

TRANSISTOR CONVERTERS. Low noise, crystal controlled. Assembled, tested printed circuit. 50-54 mc input, 14-18 mc output. $15.00 ppd. Syntelex, 39 Lucile, Dumont, N.J. 07628.

AUTOMATIC, antenna-powered (100 milliwatts) antenna tuner for any beam, $25.95. MD ELECTRONICS, Box 5843, Winston, Salem, N.C.

"HOSS-Trader," Ed Moory: Plays Santa Claus for November and December: New Equipment with factory warranty, Opened and displayed: Galaxie V, $349.00; Swan 250, $269.00; Swan 350, $349.00; NCX-5, $459.00; NCL-2000, $549.00; TR-4, $479.00; R-4A, $329.95; T-4X, $335.00; 30L-1, $429.00; 75S-3-B, $509.00; New SB-34, $339.00; Demo Ham-M Rotor, $89.95; Package Deal: New Galaxie V, A.C. supply reg. price $500.00: Cash price $409.00; Package Deal New NCX-5 and Demo NCL-2000, reg. price $1,370.00; Cash price $999.00; Demo-HAM-M Rotor and New Mosley TA-33 Beam, $179.00; RECONDITIONED GEAR: TR-3 $379.00; HT-37, $199.00; 2-B, $185.00; KWM-2, $599.00; HW-12, $99.00; 32S-1, $389.00; Famous Hoss-Trader Neckties, $1.99. "Ed Moory Wholesale Radio," Box 506, DeWitt, Arkansas. Phone 946-2820.

SEND FOR FREE copy of Ham's Market Newspaper, Box 13934, Atlanta, Georgia 30324.

HUNDRED QSL's $1.00. Samples, dime. Holland, R3, Box 649, Duluth, Minn. 55803.

QSLS, Quality printing, samples dime, refundable, Johnson, Box 245, St. Paul, Minn.

QSLS 300 for $5.00. Samples 25¢. K2HVN, 860 Atlantic St., Lindenhurst, New York.

QSL cards Ham, C.B. SWL. Free samples. Send stamped envelope to George, Box 282, Valparaiso, Florida.

QSL's 3-color glossy. Rutgers Vari-typing Service. Free Samples, Thomas Street, Riegel Ridge, Milford, N.J. 08848.

EMBOSSED QSL CARDS. Free Samples. Ace printing Service, 3298 Fulton Road, Cleveland, Ohio 44109.

THIRTEEN HUNDRED FIFTY DOLLARS cash and carry takes lock, stock and barrel equipment consisting of gpr 90 communication receiver 100v 6001 cv57 converter, one teletype printer with keyboard, one teletypeprinter with automatic line feed and carriage return, antennas and cables, instruction books for some equipment, tmc ssb adopter gsbl. All as is no returns. Alfred Popwell W2QNB, 164 Catherine Street, Westbury, Long Island, New York.

SACRIFICE HQ-150 and HC-10, SSB slicer both $175.00. Will ship. Write Vic Weissbrodt W9JFP, 2100 E. Webster Place, Milwaukee, Wisc.

TRANSISTORIZED Calibrator, $8.50, relays, transformers. Write K2OYN, 449 Hill St., Boonton, New Jersey.

WANTED—HQ 129X Receiver in mint condition if possible. State condition and price. Ernest Nettum, WØFVG, Kindred, No. Dak.

FOR SALE: So. Calif. only. GSB100 with D104 PTT Mic., $175.00. 75A4 SN814 with 500 and 2100 CPS filters, $375.00. Frank Pfeiffer, K6JIC, 4845 North Baldwin Avenue, Temple City, Calif. 91780.

SELL New SB-34 with Mic $345.00—W6BLZ, 528 Colima, La Jolla, Calif.

FOR SALE: QST's almost complete 1938 through 1964. CQ's almost complete 1953 to mid 1963. Best offer takes batch. You pay transportation. Stuart Campbell, Route 2, Box 535, Vashon, Washington 98070.

WANTED: Collins 312B-4, 75S-1. Good working condition. K6KA, Box 1, La Canada, Calif. 91011.

ALL THE EQUIPMENT YOU NEED TO START YOUR OWN 2-Way Radio Business. New, never used, 50% off. Lampkin crystal calibrator, model 111, Lampkin FM Modulation meter type 205 A, Lampkin Frequency meter model 103 B, cost $662.00 will sell for $331.00. D. R. Moler, 1342 Whitney Avenue, Hamden 17, Conn. 288-7236.

FOR SALE: CQ's own NUVISTAPLUG. (Raytronics) see Sept. 1962. Replaces these RF tubes: 6BZ6, 6CB6, 6DE6, 6DC6, 6BH6, 6CF6, 6DK6. Never used after four years! Nice! $12.50. Johnson Signal Sentry $7.50, Hy-Gains indoor SW Antenna $7.50, Walden Elect. Trans pro TM-1 CW monitor, nice! $7.50. K6OVN, 1157 Palms, Venice, Calif. 90291.

CORNELL AMATEUR RADIO CLUB auction, November 5th at Barton Hall. Bring equipment to sell.

HAVE: 4X500's, 4CX250's, 4X150's. Swap for old toy trains. W3SYT, Rockwell, 8672 Lincoln Blvd., Pittsburgh 15237.

FOR SALE . . . Heath HW-32 with HP-20 AC P/S; two 4-1000A's like new, ABT 30 hrs. use. Best offer. WANTED . . . Vocaline 465 MC Equipment: JRC-400, JRC-425, AT-30 remote type. Also 144, 220, 420 MC gear. What have you? Grant C. Armstrong WA1EEW, 49 Colonial Lane, West Dennis, Mass. 02670—phone: 617-398-9103.

VHF ROUNDUP Oct 8, Dellemortes Country Manor Rte 49, Cleveland N.Y. Speakers W3SDZ, W2IXU, W1HDQ. For information write W2RHQ, 420 Beattie Street, Syracuse, New York. Tickets $6.00. $7.00 at door.

HERE'S THE CHEAPEST way to DXCC, WAZ, WTW. Telrex TM30D wide spaced Triband Beam new March 1966 Serial 35012; yours for $225.00. Bandit 2000A converted to 2000B, Serial 439 has four new 572B's—$215.00. Heath SB-300 receiver with CW filter mint condition $175.00. K4ZJF, Milt de Reyna, 4030 Hallmark Drive, Pensacola, Fla. Phone Area 904 433-6552.

HA-350 receiver; Utica 650A 6m transceiver; "Squalo." Excellent. Thurber, 103 Fortuna, Atwater, Calif.

FOR SALE: GOLDKIT THRILLER transceiver write A. T. Cline Jr. 240 Peachtree Street NE, Atlanta, Georgia 30303.

WANTED: GOLDKIT THRILLER or E137 DX unit box 1220 Jacksonville, Florida.

WANTED—QST's—Last four issues needed to complete private collection. 1916—FEB., MAY, JUNE, JULY. Any reasonable price paid. K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., New York 11050.

WANTED . . . Silver dollars. Any condition, will buy or trade. Drop a line if you have any other coins for sale or trade. Scott Cowan, Dept. J5, 73-62 Bell Blvd., Bayside 64, N.Y.

VIKING VALIANT II 250 Watt Phone transmitter, never used—Cash & Carry $150. Jr. H.S. 74 Queens, 61-15 Oceania Street, Bayside, N.Y. BA 4-8423.

SUBMINIATURE: A complete line of tiny radio transmitting devices, including cordless microphones, telephone transmitters, etc. Applications: surveillance, business, industrial, monitoring. Price range: $150.00 up. Literature available. L. N. Schneider, 958 Alan Drive, Wantagh, N.Y.

SURPLUS NEEDED

Guaranteed highest prices. Shipping paid. We'll buy, trade or give you new equipment of your choice. Send list or telephone for immediate quote. Payment in 24 hrs.

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It is easy and pleasant to learn or increase speed the modern way—with an **Instructograph Code Teacher.** Excellent for the beginner or advanced student. A quick, practical and dependable method. Available tapes from beginner's alphabet to typical messages on all subjects. Speed range 5 to 40 WPM. Always ready, no QRM. beats having someone send to you.

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4700-C Crenshaw Blvd., Los Angeles, Calif. 90043

For further information, check number 32, on page 110

QUARTER CENTURY WIRELESS ASS'N INC

Quarter Century Wireless Association, Inc.

Licensed amateurs who held an amateur license 25 or more years ago are eligible for membership.

Entry Fee **$3.00** 3 Years Dues **$5.00**

Applications may be obtained from

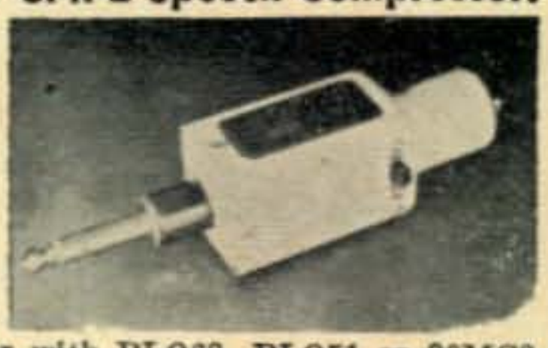
A. J. Gironda, W2JE, Executive Secretary
1417 Stonybrook Avenue, Mamaroneck, N.Y.

For further information, check number 33, on page 110

Boost Talk Power!

With our NEW, IMPROVED CPR-2 Speech Compressor!

- **TRIPLES SSB output power or AM modulation!**
- **NEW adjustable compression control!**
- **For ALL transceivers, transmitters, and P.A. systems!**
- **For ALL microphones!**
- **Internal battery**



With single button connectors, or with PLO68, PLO51 or 80MC2 connectors for Push-to-talk (effective Nov. 1, 1966).....**$19.95**

FULLY WARRANTED . . . . . MONEY BACK GUARANTEE

Send for full description of our product line.

COMMUNICATION COMPONENTS CO.
P. O. Box 8721 • Dept. B • Orlando, Florida 32806

For further information, check number 34, on page 110

DX - - DX - - DX - - DX

SHORT PATH **QSL-ing**

DON'T WASTE MONEY / WASTE STAMPS / WASTE COUPONS

DO SAVE TIME / BEAT THE COMPETITION / RAISE YOUR SCORE / QUICKER

90% of active DX stations have STATE-SIDE QSL managers. Our copyrighted "QSL MANAGERS DIRECTORY" lists over 2000 of these managers and has now been up-graded to a complete service—you receive:

THE QSL MANAGERS DIRECTORY
QUARTERLY SUPPLEMENTS listing changes — deletions — additions.
A COMPLETE LIST OF QTH's for the above managers.
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Los Angeles, Cal. 90054 (Founder W6GSV)
European Agent: DX NEWS SHEET—GEOFF WATTS
62 Belmore Road, Norwich, NOR72T ENGLAND

For further information, check number 35, on page 110

A NEW MOBILE CONCEPT

MOBILTRANS 40

Complete 40W Transmitter and
Receiving Converter in a Single Unit
Including Power Supply!

40/75/160

LOW COST • NEW DESIGN

MOBILTRANS provides the amateur with a low cost mobile installation utilizing the existing car radio for receiving. New design provides exceptionally low battery drain.

- Modulated carrier amplitude controlled by voice.
- Stand-by drain less than 300 ma at 12 volts.
- Contains 9 transistors, 6 diodes, one tube.
- Available for either 40, 75 or 160 meters.
- Accessory coils available for band change.
- Three position crystal selector (FT-243 type).
- Operating wt. 5 lbs. Size: 2⅞" H, 8" W, 8¼" L.
- For 12 volts negative ground ONLY.

$99.50

For Detailed Brochure, Write or Wire:

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READER SERVICE

NAME_____ CALL_____
(Please Print)

ADDRESS_____

CITY_____

STATE_____ ZIP CODE_____

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THE HEART

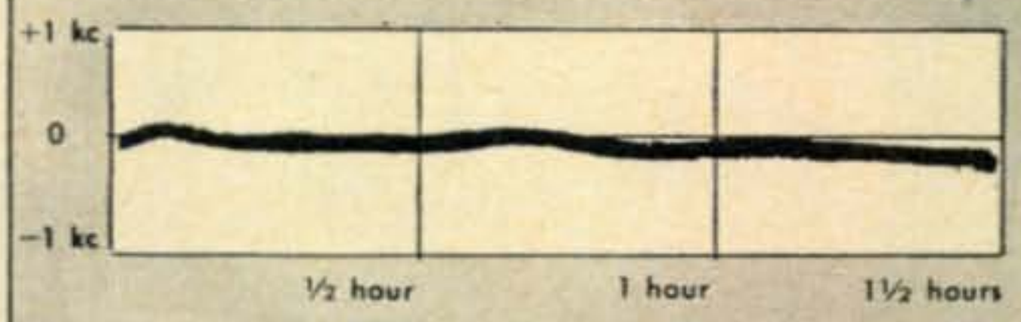
OF ANY TRANSCEIVER *IS ITS*

VFO STABILITY

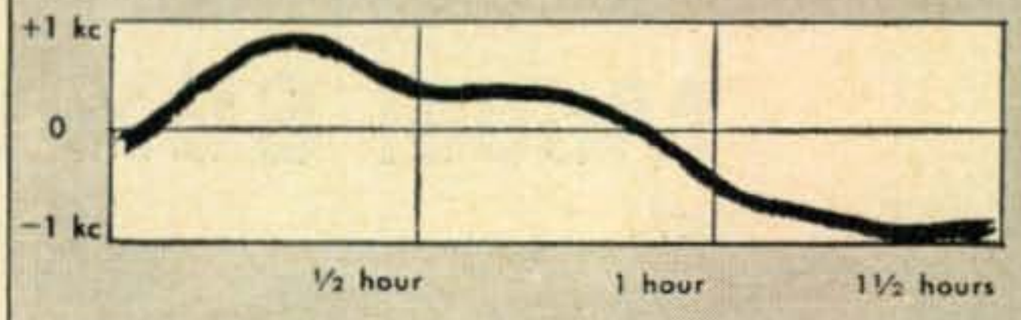
so, Compare the steady "heartbeat" of the

GALAXY V

with that of its strongest Competitor!



This is the "heartbeat" of a Galaxy V picked at random from our assembly line! Note the minimum of drift in a 1½ hr. test!



This is the "heartbeat" of a well-known competitive transceiver. (Also picked at random.) Note the excessive drift that occurred during the same 90 minute test period!

Every Galaxy V that comes off our line goes through this exacting test! It amounts to a 90 minute "electrocardiogram" on VFO stability, *the "heart"* of any transceiver.

Every Galaxy's *VFO* stability must meet our exacting low-drift requirements! *The personal drift-chart of every Galaxy that comes off the line goes with the unit to its new owner.*

It's just one of many Galaxy requirements to insure the set's owner of the standard of performance we feel he is entitled to get! Others include *vibration testing* (a real torture test); *full power* (300 watt) *key down testing* over several hours; actual *on-the-air* contacts to assure superior audio quality; and a *final test of scope and sweep alignment of the filter.*

And speaking of filters—The super-selective filter in the Galaxy is no "Johnny-come-lately"! For over 2 years it has been the *most selective filter* in any Ham transceiver, and it still is! It is just 2.1 kc wide (−6 db points) and this, coupled with the shape factor of 1.8:1 means it is just 3.78 kc wide (at the −60 db points) *where the strong signals are!* THAT MEANS YOU HEAR LESS INTERFERENCE! Don't be MISLED! ...Shape Factor alone does not tell the story. A barn with a nice shape factor of 1:1 is still broad as a barn where the INTERFERENCE is!

GALAXY V

The most Powerful—Reliable—Rugged Transceiver Anywhere!

$420

80-40-20
15-10
Meters
300 Watts

See the GALAXY V! Write us for the name of the Dealer nearest you!

GALAXY ELECTRONICS

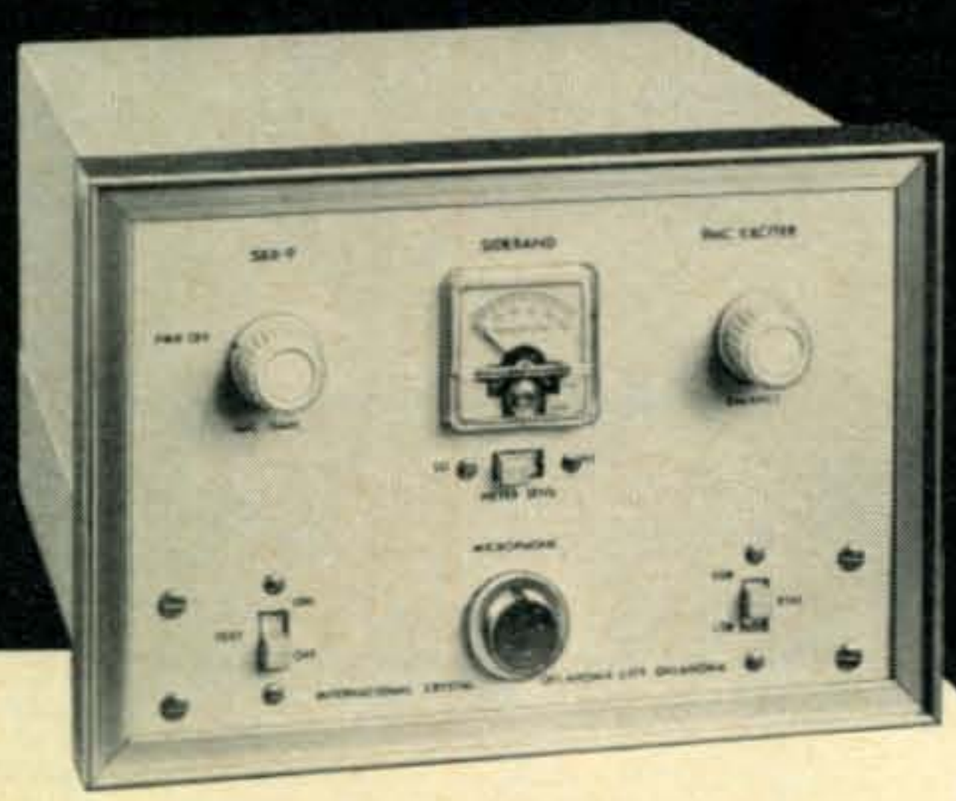
10 South 34th Street • Council Bluffs, Iowa 51501

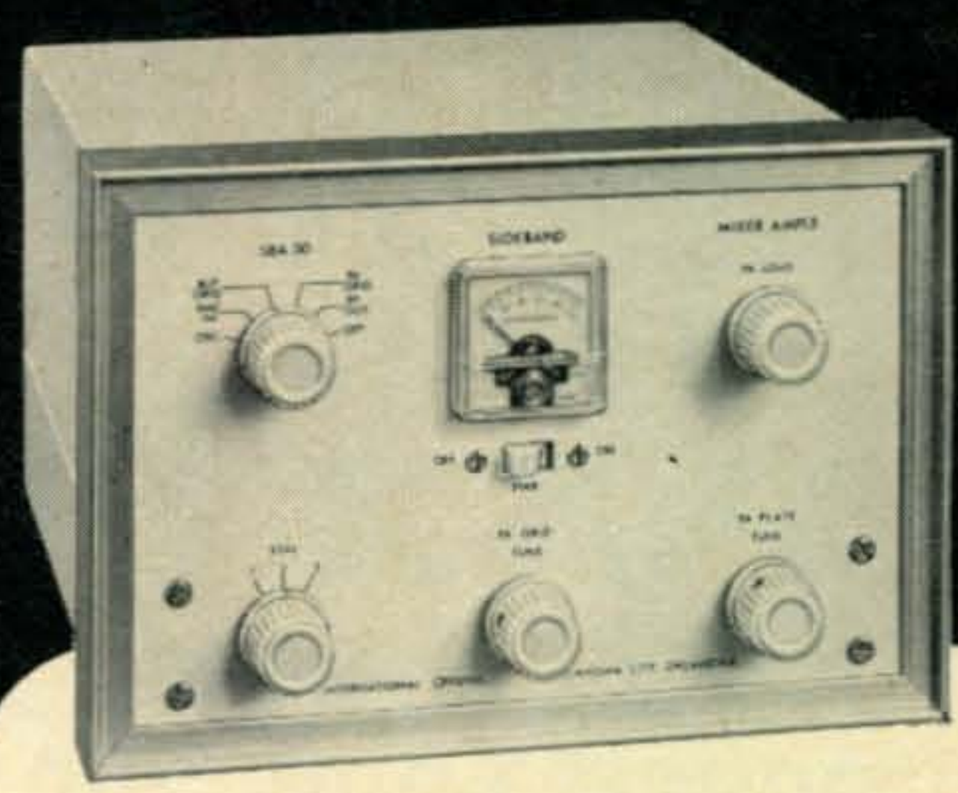
For further information, check number 40, on page 110

NEW from International

SINGLE SIDEBAND
9mc EXCITER-DRIVER
50-54mc MIXER-AMPLIFIER

The SBX-9 Exciter-Driver and the SBA-50 Mixer-Amplifier provide the perfect combination for 50-54mc SSB operation. Performance, versatility and reliability are incorporated into this new SSB pair. A tremendous value at a low price!





Model SBX-9

SPECIFICATIONS:
Exciter-Driver 9mc

Tubes:	6BH6 Oscillator 12AX7 Audio 7360 Bal Modulator 6BA6 RF Amplifier
Filter:	Four crystal half lattice Carrier Suppression 45db min. Unwanted SB Atten. 40db min.
Output:	Provides voltage drive for mixer such as SBA-50
Controls:	Carrier Balance Microphone Gain Test Switch USB-LSB Switch
Metering:	RF output for balance adjust. Two sensitivity ranges available with front panel switch.
Misc:	Relay included for push-to-talk operation. Crystals for upper and lower sideband included. Requires high impedance microphone. For operation on 117 vac 60 cycle power.

$125.00

Model SBA-50

SPECIFICATIONS:
Mixer-Amplifier 50-54mc

Tubes:	6U8A Oscillator-Mixer 12BY7A Amplifier 6360 Linear power amplifier
Drive:	Requires 9mc sideband signal from SBX-9
Output:	SSB single tone 10 watts
Controls:	On-Off Power PA Grid Tune PA Plate Tune PA Load Tune Metering Switch
Metering:	Oscillator 9mc Drive Buffer Grid PA Grid RF Out
Crystals:	Three positions, uses 3rd overtone 41-45mc range. Crystal frequency = final frequency —9mc
Misc:	Accessory socket provided for connecting keying circuit to SBX-9. Comes with three crystals. Specify frequency when ordering. For operation on 117 vac 60 cycle power.

$145.00

Order direct from International Crystal Mfg. Co.

INTERNATIONAL

CRYSTAL MFG. CO., INC.

18 NO. LEE · OKLA. CITY, OKLA. 73102

For further information, check number 4, on page 110

New from National
The most versatile 5-bander on the market ...priced even lower than a kit rig!

Here's the fastest way to move up from single band or triband operation . . . the all-new National 200. It's a fabulous five-bander, an ideal rig for mobile, portable, or home operation . . . and it's only $359! For the first time at this amazingly low price, you get top-notch SSB, CW, and AM performance on the 80 through 10 meter bands . . . plus National's traditional quality and full One-Year Guarantee.

Only National gives you these important features: ■ Complete coverage of the 80 through 10 meter bands. ■ 200 Watt PEP input on SSB, plus CW and AM. — Separate product and AM detection plus fast-attack slow-release AGC. ■ Crystal-controlled front end and single VFO for high stability, and identical calibration and tuning rate on all bands. ■ Crystal lattice filter for high sideband suppression on transmit, and rejection of adjacent QRM on receive . . . plus solid-state balanced modulator for "set-and-forget" carrier suppression. ■ Operation from new low-cost AC-200 supply or from NCX-A or mobile power supplies. ■ ALC. ■ 45/1 planetary/split gear tuning drive. ■ Automatic carrier insertion in AM and CW modes. ■ Panel meter automatically switched to S-units on receive. ■ Universal mobile mount included.

ONLY $359.
with National's full One-Year Guarantee

National Radio Company, Inc.
37 Washington Street, Melrose, Massachusetts 02176

For further information, check number 51 on page 110

570

RCA-8122 beam power tetrode shown actual size.

watts

output in Class AB_2

The RCA-8122 has power and reliability that's *hard to beat*—more than 50% greater dissipation capability than older tubes of comparable size. Used in the latest commercial equipment, or in your own project, the RCA-8122 can deliver power and efficiency with as little as 5 watts drive.

This low-cost forced-air-cooled beam power tube is designed with the builder in mind. . . . Use it with coaxial, strip-line, or conventional lumped tank circuit construction. Get broad-band neutralization on upper frequencies with only a series-tuned capacitor in one cathode lead. Ceramic-and-meta' construction and special electrode configuration eliminate mechanically-caused noise and provide extreme sturdiness even at high operating temperatures.

Whether you're planning to buy or build, make sure you take advantage of the latest advances in tube technology with the RCA-8122—made by the people who gave you the 6146. On the amateur bands, it's years ahead!

Full CCS ratings up to 500 MHz. For use as rf power amplifiers; oscillator; regulator; distributed amplifier or linear rf power amplifier in fixed or mobile equipment . . .

- 380 Watts PEP Output at 30 MHz Class AB_1
- 570 Watts PEP Output at 30 MHz Class AB_2
- 300 Watts CW Output at 470 MHz Class C

For complete technical information, write to RCA Commercial Engineering, Harrison, N. J. for a copy of RCA-8122 Data Bulletin (Revised 6-66), and Application Guide ICE-300.

AVAILABLE THROUGH YOUR AUTHORIZED RCA INDUSTRIAL TUBE DISTRIBUTO

RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

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